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Aging Changes in the Human Atrioventricular Node, Bundle, and Bundle Branches

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THIS communication deals with the changes in histologic features of the a-v node and bundle with advancing age. Its purpose is (a) to constitute a basis for the study of pathologic change and (b) to aid in the solution of the question of the specificity of this tissue. Such studies have partially been carried out by Mönckeberg (6) and Rondolini (9). Both concluded that there was a difference in the characteristics of the fibers, in the connective and elastic tissue network, and in the rate of growth between this tissue and the remainder of the myocardium.

MATERIALS AND METHODS

Fifty-five formalin-fixed hearts of various ages (table 1) were cut in a manner devised by Lev, Widran, and Erickson (5), based on gross dissection of the a-v node and bundle by Widran and Lev (12). These sections were stained with hematoxylin and eosin. In addition, 13 hearts, similarly cut, were fixed either in 10 per cent formalin, Zenker's, Susa's, or Rossman's fixatives. The ages of this group were: 5½ months' gestation (2 cases); 7 months' gestation (2 cases); 1 year; 21, 35, 37, 42, 65, 70, and 81 years. These sections were stained with hematoxylin and eosin, Weigert's elastic counterstained with van Gieson's, Hortega's reticulum, Hotchkiss' glyco-protein, Heidenhain's azan, and Mallory's phosphotungstic acid-hematoxylin.

TABLE 1. CASES STUDIED HISTOLOGICALLY, ACCORDING TO AGE GROUP.

Age	Number
Fetus	2
0–10	9
11–20	4
21–30	3
31–40	6
41–50	14
51–60	12
61–70	5
	Total 55

GENERAL HISTOLOGIC CHARACTERISTICS

Node: The fetal node consists of a mass of closely packed epithelioid cells (fig. 1, a). The nuclei are oval, with a transverse diameter equalling that of the nuclei of the atrial and ventricular musculature. In length they equal those of the atria but are somewhat shorter than those of the ventricles. There are numerous mitotic figures, which are equally numerous in the atrial and ventricular musculature. The cytoplasm of the cells, however, is distinctly paler than that of the latter. Surrounding the node are endothelial cells, lining what seem to be partially or completely collapsed spaces. By the time of 7 months' gestation to birth, the nodal cells begin to resemble short muscle cells arranged in a network of interdigitating fasciculi. These cells are less in length and diameter than the atrial, and much less in length and diameter than the ventricular muscle cells. The cytoplasm, however, remains paler than the latter. It is now noted that the endothelial-lined tissue interdigitates between the fasciculi, contributing to the marked cellularity of the node.

By the time of adulthood (fig. 1, b) there is a marked difference in both length and

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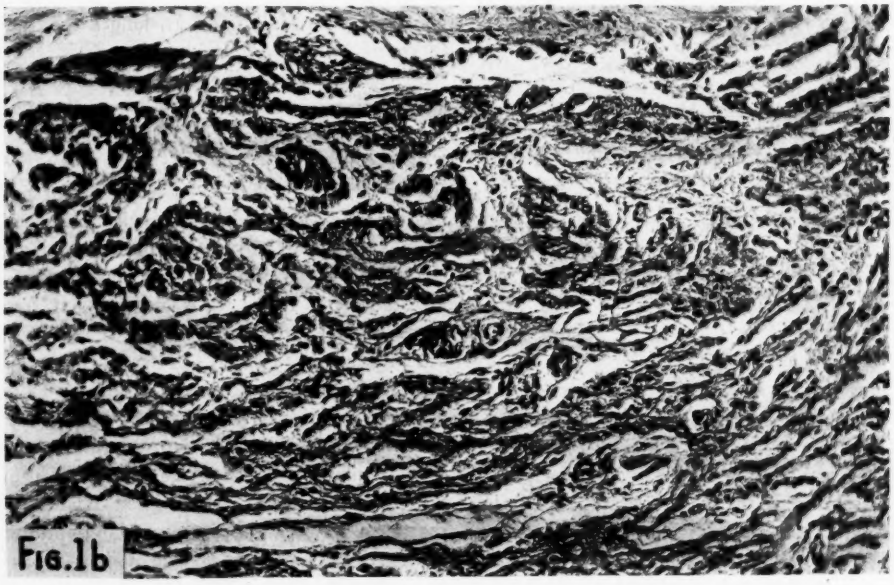
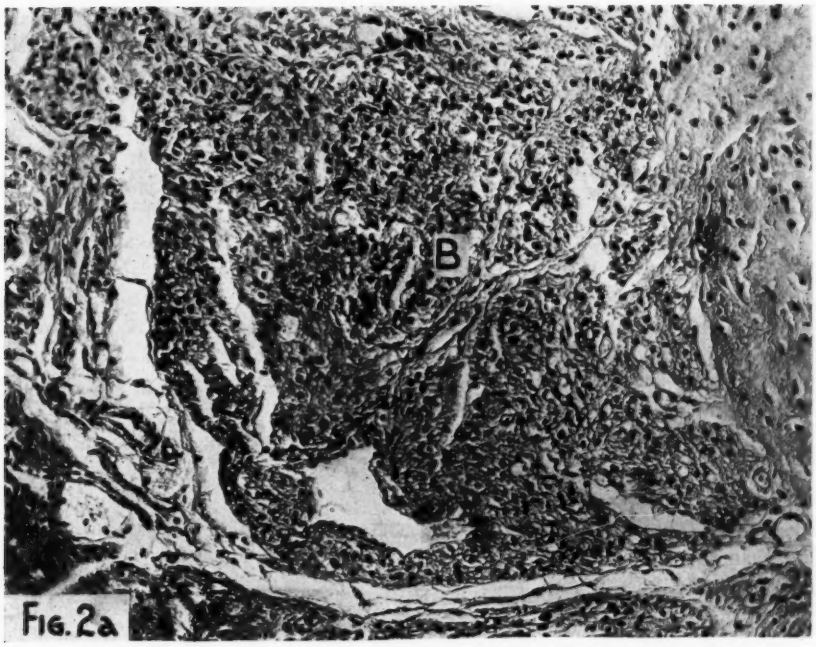


FIG. 1. Photomicrographs of the a-v node.
a. In a fetus of 5 months' gestation. Hematoxylin-eosin stain. X 100.
N — node
b. In the adult. Hematoxylin-eosin stain. X 100.



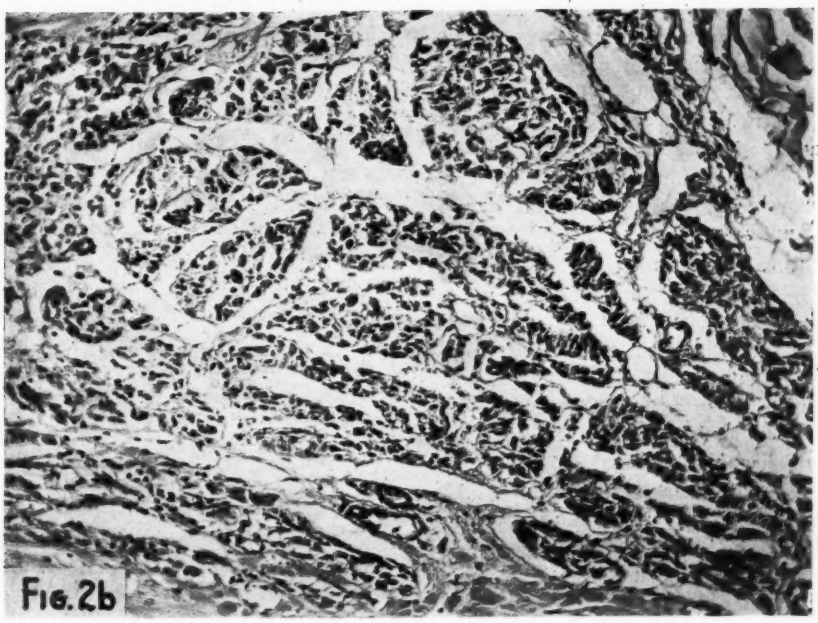


Fig. 2. Photomicrographs of the a-v bundle.
a. In a fetus of 5 months' gestation. Hematoxylin-eosin stain. x 100.
B — bundle
b. In the adult. Hematoxylin-eosin stain. X 180.

diameter between nodal and atrial and ventricular muscle cells. This is due to the marked growth of the two latter in comparison to the slight growth of the former. Likewise, although the cytoplasm of the nodal cells becomes more eosinophilic, it remains paler than that of the cells of the atria and ventricles. The nuclei, although they become more longitudinally oval, do not take on the rectangular forms of the cells of the atria and ventricles. Their longitudinal diameter is less than that of the atrial, and much less than that of the ventricular muscle cells. Their transverse diameter is only slightly less than that of the atrial, but moderately less than that of the ventricular muscle fibers.

Bundle: The fetal bundle, like the node, consists of relatively closely packed epithelioid cells (fig. 2, a). By 5 to 6 months of gestation (earlier than the node), the bundle cells take on the form of short muscle cells arranged in parallel, slightly branching and communicating fasciculi. These cells are slightly smaller in length and transverse diameter than those of the ventricles but equal those of the atria. The cytoplasm of these cells is also more lightly stained as compared to that of the atrial and ventricular muscle cells. The nuclei are oval and slightly shorter than those of the ventricular muscle cells. Their transverse diameter, however, equals that of the atrial and ventricular muscle cells.

From the early days of fetal life, a space lined by endothelial cells surrounds a part or all of the bundle. These cells are continuous with those found around the node. They likewise interdigitate with the bundle fasciculi to produce the appearance of increased cellularity. By adulthood, as in the node, the fibers are much smaller than the atrial and, of course, than the ventricular muscle (fig. 2, b). Although the cytoplasm becomes more eosinophilic, it lags behind that of the atrial and ventricular muscle fibers in staining. The nuclei are much smaller, especially in length, but also in breadth, than those of the ventricular fibers. This difference is less marked when compared to the atrial musculature.

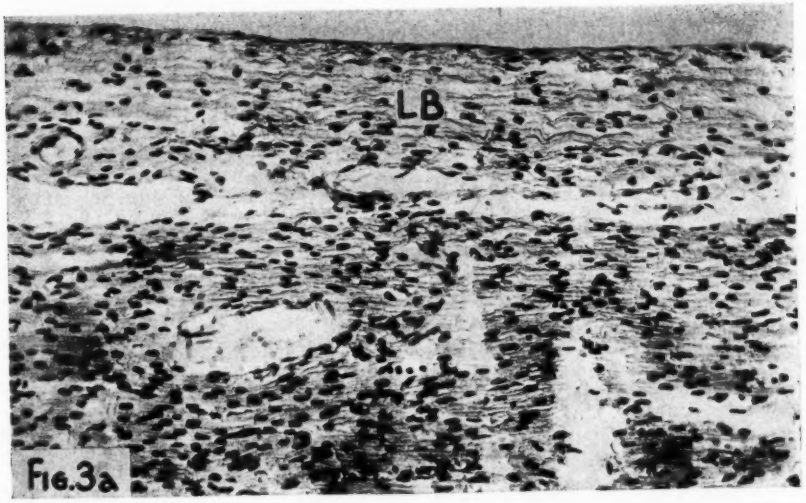
Left bundle branch: In prenatal life, the fibers of the left branch resemble the structure of the bundle for a short distance. More distally, the cells become larger than those of the ventricular myocardium. This is due to the relative abundance of cytoplasm, which again is paler than that of the cells of the ventricular myocardium (fig. 3, a). The nuclei are longitudinally oval and equal in size to those of the cells of the ventricular myocardium. By adulthood, the fibers increase in size at the same rate as those of the ventricular myocardium, with the result that they remain larger than the latter and assume the typical picture of Purkinje cells (fig. 3, b). The endothelial cells which surround and interdigitate with the bundle continue in a like manner in the left branch up to its termination.

Right bundle branch: In all ages, the beginning of the right branch resembles the bundle strongly (fig. 4, a). Progressively downward, however, the cells become very similar to those of the right ventricular myocardium in both size and tinctorial characteristics (fig. 4, b and c). Only close to its termination at the moderator band do some of the cells become larger, contain paler cytoplasm, and resemble Purkinje cells. The endothelial cells of the bundle and their containing spaces continue downward into the right bundle branch to its termination.

A study of myofibrils and striations with Mallory's phosphotungstic acid-hematoxylin reveals the following: the light staining of the cytoplasm of all parts of this system is due to a lesser number of myofibrils (fig. 5, a, b, and c). These, however, are striated, as are those of the myocardium. At any one age, there are fewer myofibrils in the node as compared to the bundle. Intercalated discs were not studied specifically here. Routine studies reveal a lesser number of discs in all parts of the system as compared with the myocardium.

Changes in Elastic and Collagen Networks, Fat Tissue, and Basement Membranes with Advancing Age

In the fetal node and bundle, a slight collagen network is present. Shortly after birth



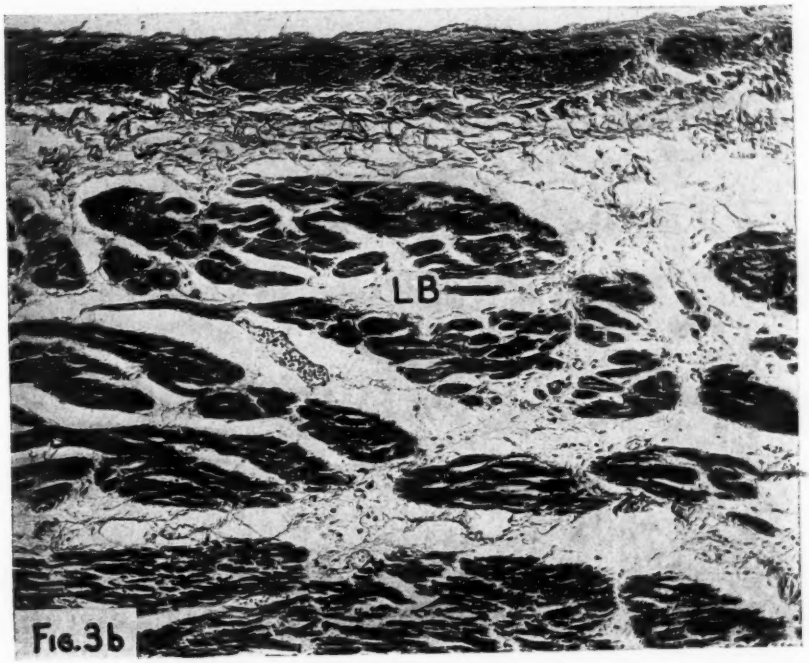
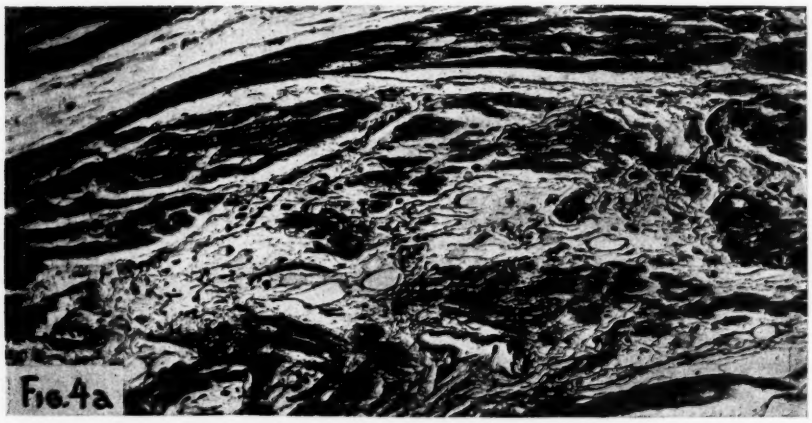
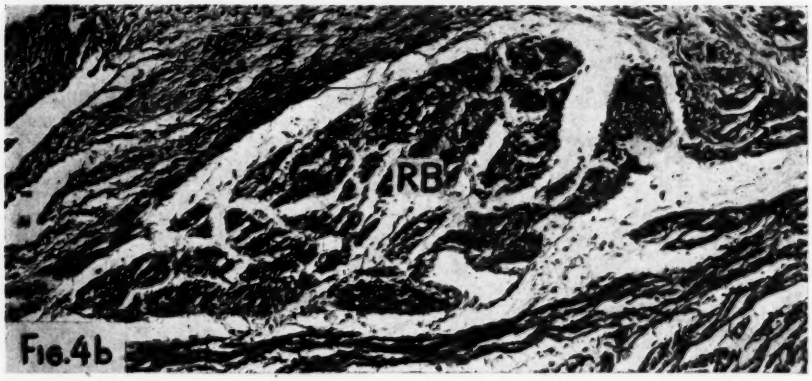


FIG. 3. Photomicrographs of the left bundle branch.
a. In the fetus. Hematoxylin-eosin stain. X 200.
LB — left bundle branch
b. In the adult. Hematoxylin-eosin stain. X 100.
LB — left bundle branch





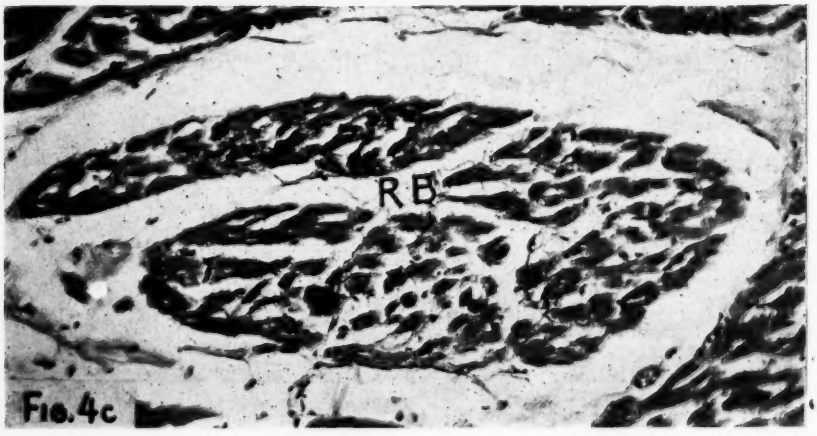
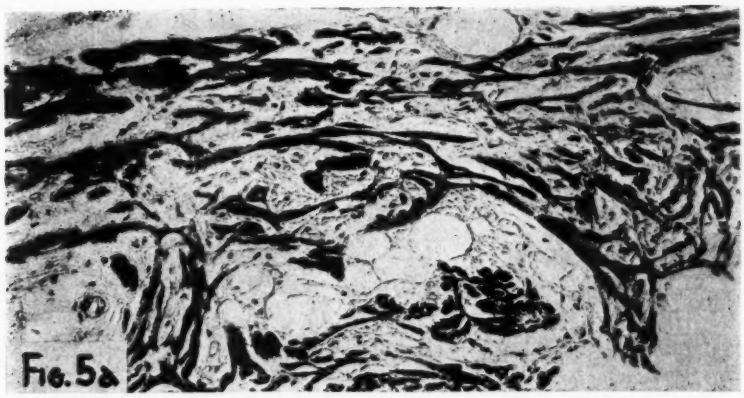


FIG. 4. Photomicrographs of the right bundle branch.

a. At origin from bundle (adult). Hematoxylin-eosin stain. X 180.

b. In the first portion (newborn). Hematoxylin-eosin stain. X 100.
RB — right bundle branch

c. In midportion (adult). Hematoxylin-eosin stain. X 200.
RB — right bundle branch



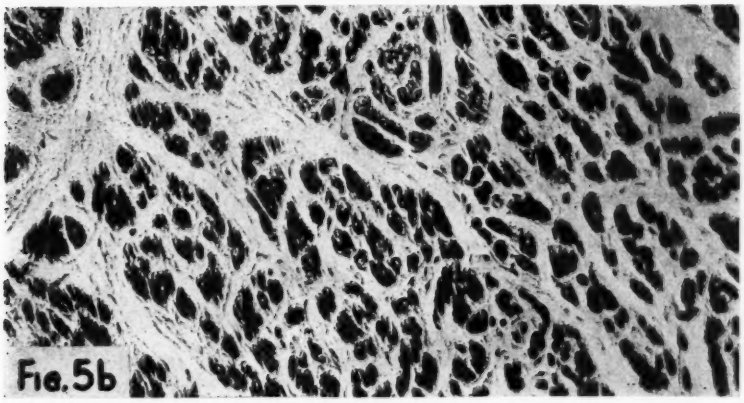
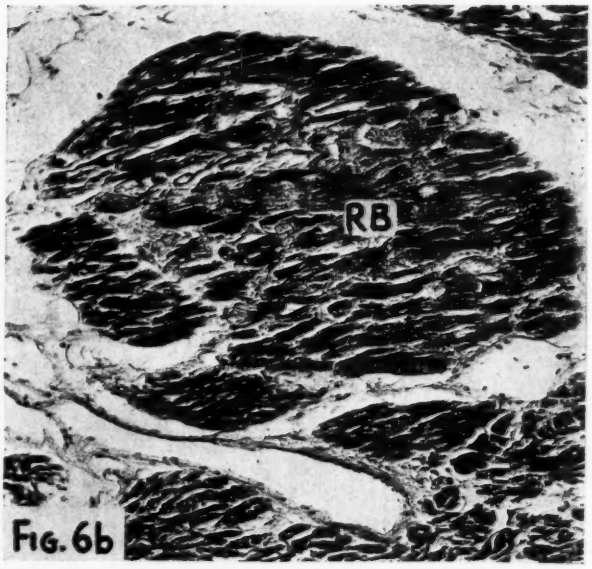


FIG. 5. Photomicrographs of node, bundle, and ventricular myocardium. Phosphotungstic acid-hematoxylin stain. X 180.

a. Node
b. Bundle
c. Ventricular myocardium



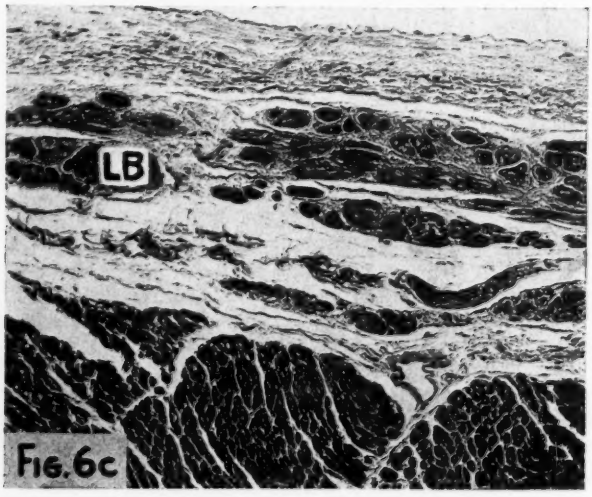


FIG. 6. Photomicrographs of bundle and bundle branches, showing an increase in connective tissue. Hematoxylin-eosin stain.

a. Bundle. X 20.
b. Right bundle branch. X 200.
c. Left bundle branch. X 100.

B — bundle
LB — left bundle branch
RB — right bundle branch
A — atrial musculature
V — ventricular musculature

this increases only slightly up to adulthood. After 45, however, there is a considerable increase in collagen fibers (fig. 6, a, b, and c). In the fetal node, bundle, and bundle branches, elastic tissue is very scant. At birth or slightly thereafter, elastic fibers become prominent—considerably in excess of those noted in the musculature of the atria and ventricles (fig. 7). The predominance of elastic tissue in these structures over that in the remainder of the myocardium is a distinguishing feature from then on in all age groups. In old age, the elastic tissue becomes very abundant.

Following the concept of Gersh and Catchpole (3), the muscle fibers of the myocardium and of the node and bundle may be said to be surrounded by basement membranes consisting of reticular and glycoprotein components. The reticular network of the fetal node and bundle shows fine meshes of sharp, reticular lines. This is in contrast to the ventricular and atrial myocardum, where the network is in larger meshes enclosing larger branching cords.

By adulthood, the reticular network of the ventricular myocardium is sharp and dense and surrounds each individual fiber. That of the node and bundle simulates this pattern, but the meshes are much smaller. Thus there is no real differentiating characteristic of the reticular network of the node and bundle. However, the reticular network of the left bundle branch is distinctly sharper and denser than that of the remaining left ventricular myocardium in fetal life and in all subsequent age groups (fig. 8). This is not true of the right branch, which simulates that of the right ventricular myocardium.

The glycoprotein component of the basement membranes shows the same characteristics as

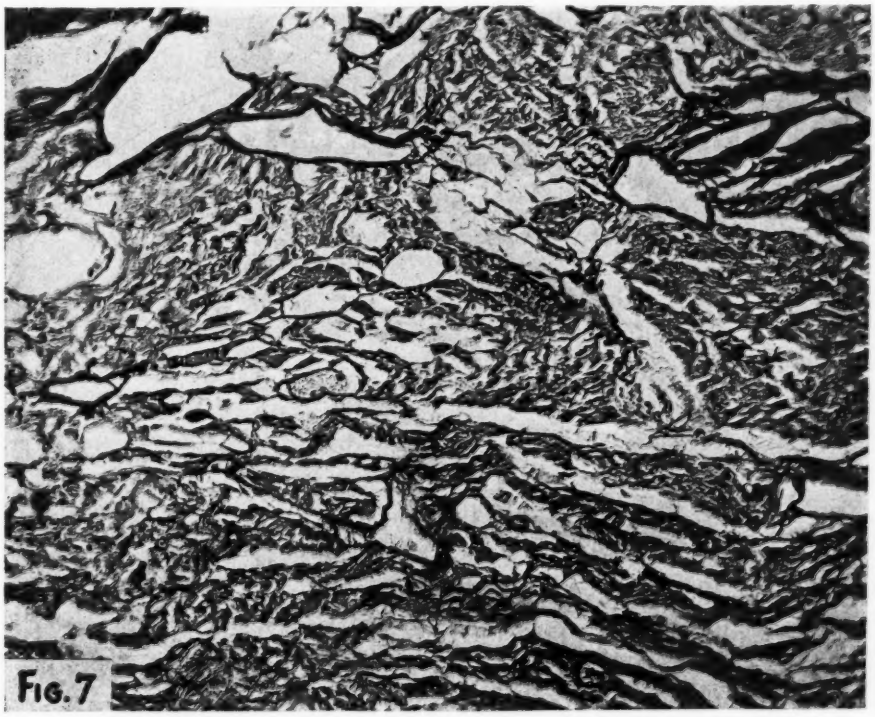
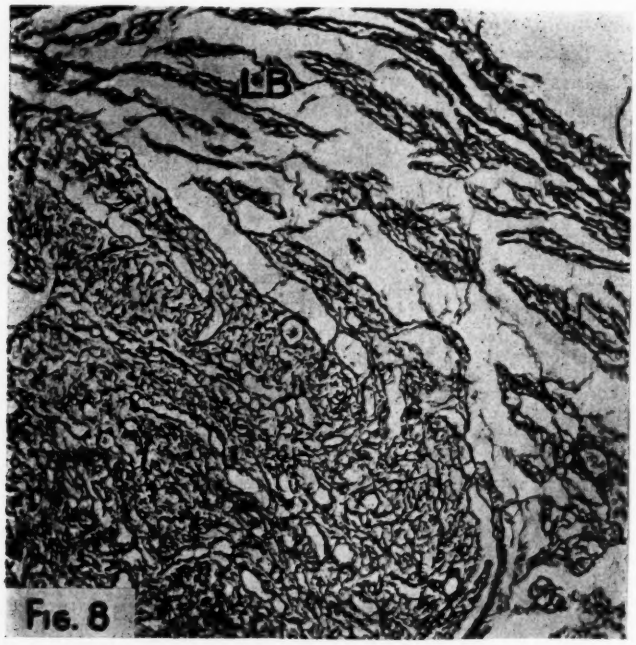


FIG. 7. Photomicrograph of node (adult), showing elastic network. Weigert's elastica with van Gieson's connective tissue stain. X 180.



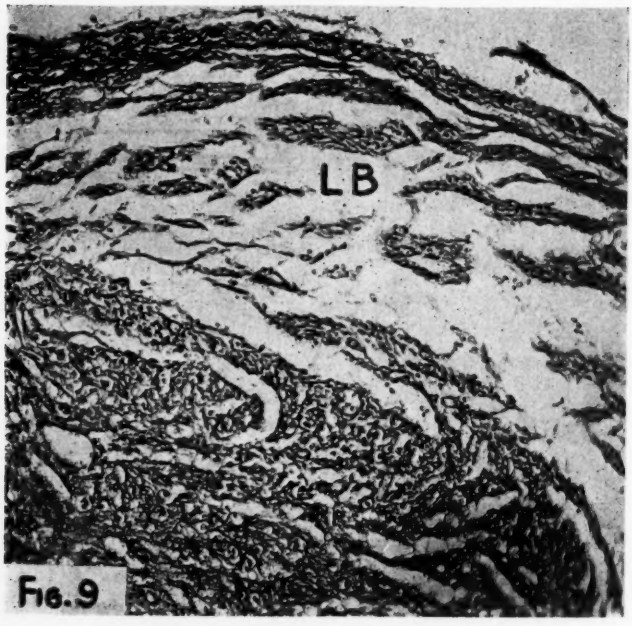


FIG. 8. Photomicrograph of beginning of left bundle branch, showing reticular network. Hortega's reticulum stain. X 200.
LB — left bundle branch

FIG. 9. Photomicrograph of beginning of left bundle branch, showing the glycoprotein component of the basement membranes. Hotchkiss' stain. X 190.
LB — left bundle branch

the reticular component. However, that of the left branch is only slightly sharper than that of the myocardium (fig. 9).

Beginning at about the age of 30 and becoming very prominent after 50, there is a marked infiltration of fat into the node (fig. 10). This may extend into the bundle and into the beginning of the right and left branches.

The study of nerve fibers in the a-v node, bundle, and bundle branches in the various age groups is in progress.

Discussion

The present observations reveal that there are certain differentiating characteristics pertaining to the entire system, and certain further differentiating characteristics in each part of the system. The entire system is differentiated by (a) the endothelial-lined sheath, (b) the lesser number of myofibrils, and (c) the increased amount of elastic tissue. The node is further differentiated by its reticulated structure and the small size of its fibers. The latter characteristic pertains to the bundle as well. The left branch is characterized by the large size of its fibers in the distal four-fifths and the sharp, reticular component of the basement membrane. The right bundle branch has no other differentiating characteristics. These facts favor the concept that these structures are histologically specialized, as maintained by Tawara (11), Keith and Flack (4), Mönckeberg (6), Pace (8), Blair and Davis (1), Rondolini (9), Davis (2), Nonidez (7), and Stotlar and Mahan (10). This, of course,

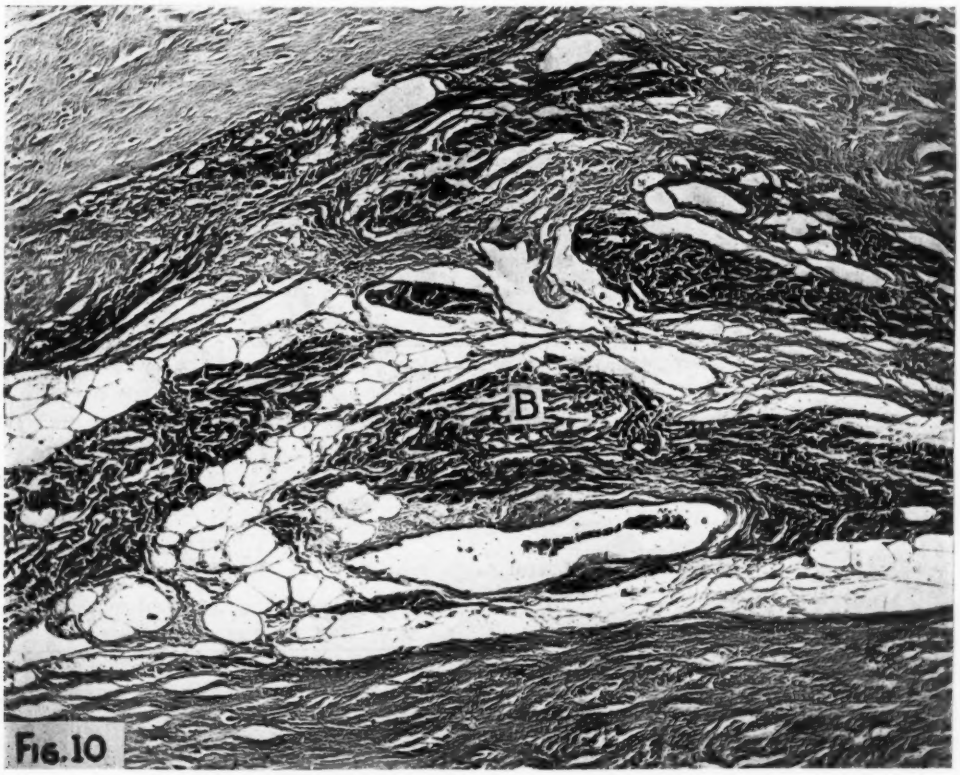


FIG. 10. Photomicrograph of bundle in old age, showing infiltration of fat. Hematoxylin-eosin stain. X 100.
B — bundle

does not necessarily imply that we are dealing with a "conducting" system.

Summary

The a-v node, bundle, and bundle branches have been studied histologically in various age groups.

This study reveals that there are distinct differentiating characteristics to these structures, speaking in favor of a histologic specificity.

This investigation was supported by a research grant from the National Heart Institute of the National Institutes of Health, Public Health Service. (H-430C).

Acknowledgment is made to Mrs. Helen Klassen for her technical assistance.

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Studies in Experimental Atheromatosis

Atheromatosis and Hepato-Atherosis in Geese. Possible Reversibility and Clinical Implications

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ATHEROMATOUS disease has been produced experimentally in a variety of laboratory animals. Anitschkow (1) demonstrated vascular lesions in the aorta of the cholesterol-fed rabbits resembling human atherosclerosis. Subsequently, Leary (11) confirmed these observations, and Steiner and associates (15), Wolffe and associates (19), and others produced similar lesions in experimental animals. Atheromatous changes in animals have also been produced by many other methods (4, 6, 14). An excellent review of this subject has been given by Hueper (10).

The observations by Aschoff (2), Winternitz, Thomas, and Le Compte (18), and others, indicate that the cause of arteriosclerosis is probably not to be found in a single factor.

For the past quarter of a century, it has been our impression that insufficiency of one or more internal secretions of the pancreas is one of the etiologic factors of atheromatosis. For that reason we have employed various fractions of the pancreas in the treatment of atheromatosis and its sequellae, both clinically and experimentally. The present investigation deals with the reversibility of atheromatosis and hepato-atherosis in geese by such treatment.

METHODS

The reasons for employing geese in the study of experimental atheromatosis have been described in detail in a previous publication (24). The spontaneous atheromatosis in these birds shows close similarity to that observed in man (7).

The resemblance between the heart and blood vessels in geese and in man is demonstrated in figure 1, a and b. However, whereas the elastic layer of the intima in the large and medium sized arteries in the human is well defined, this is not the case in the arteries of the geese, in which vessels a distinct line of demarcation is missing.

As shown in figure 2, a, the goose liver is also similar in structure to the human liver. The color of the liver in normal wild birds likewise resembles the color of the human liver (fig. 11, a), whereas in normal confined geese the color is a lighter brown, and microscopically more fat globules can be demonstrated (fig. 2, b).

The present study includes observations on the pathologic changes produced by force feeding of the geese with large quantities of food with and without cholesterol addition and investigations on the effect of pancreatic extract administered intramuscularly to the two groups of force fed geese.

The pancreatic extract was prepared from beef essentially as described by us in 1931 (20). In the present preparation, however, the insulin fraction was retained and two other fractions were extracted with weaker acid-alcohol concentrations and combined in one solution.

One cc. of the pancreatic extract contained the following:

a) Insulin, 3 to 5 units,

b) Desympatone, a parasympathicomimetic substance capable of neutralizing 10 μg. of epinephrine in a urethanized and atropinized rabbit (8, 9, 12, 13, 17, 21, 22, 25).

c) Lipolysin, a lipotropic fraction described by us in 1935 (22) which we believe to be similar to the fat-influencing hormone (lipocaic) reported by Dragstedt and his group in 1936

FIG. 1, a. Section of the human aorta showing a well defined intima. The media is seen to be composed of a network of elastic fibers connected with a fenestrated inner layer. The muscle fibers are seen to be comparatively short with long rodshaped nuclei. Stained with Mallory's Aniline Blue. Magnification 100 X.

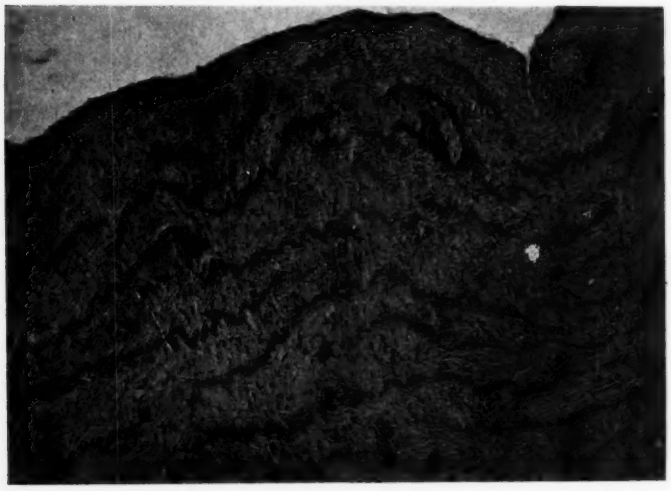

FIG. 1, b. Section of goose aorta showing a well defined endothelial layer of the intima, but apparently no limiting elastic layer as seen in human sections of this artery. Stained with Mallory's Aniline Blue. Magnification 100 X.

(5). No precise method of standardization is available for this substance. However, each cubic centimeter of the extract contains a weighed amount of lipolysin in its solid form, which is 25 mg. This amount is equivalent to 20 gm. of raw beef pancreas trimmed of fat.

Thirty-two geese approximately 8 months old (mixed strain) were divided into four major groups of 8 each.

Group I: Eight geese were unconfined and allowed to rummage for their food on a farm

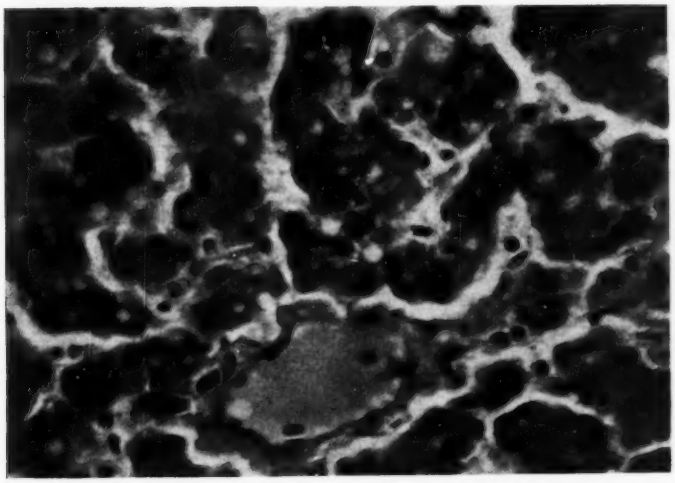

FIG. 2, a. Normal goose liver of an unconfined bird (control). Stained with hematoxylin-eosin. Magnification 150 X.

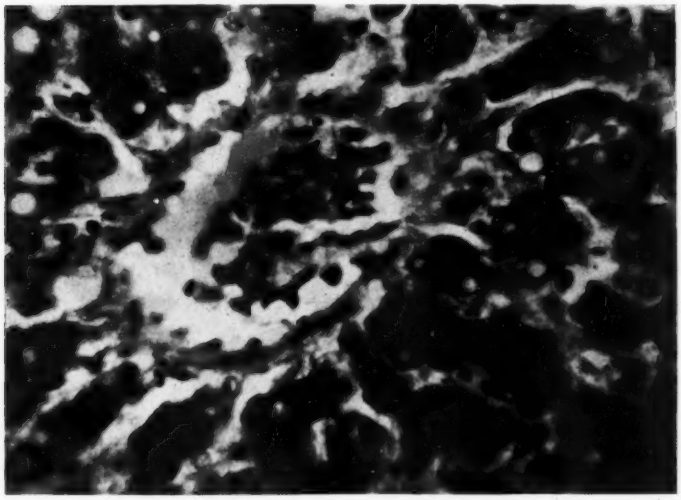

FIG. 2, b. Normal goose liver of a confined bird showing liver cell cord and sinusoids. Clear oval fat spaces are seen, the fat having been removed by dehydration. The amount of fat present was commensurate with the amount expected due to confinement of the bird and lack of exercise. Stained with hematoxylin-eosin. Magnification 150 X.

and creek in addition to barn feeding. The latter was done to keep them accustomed to one place where they could be rounded up.

Group II: Eight geese were individually confined in small cages, watered, and fed ad libitum with common poultry feed (table 1).

Group III: Eight geese were individually confined in small cages, but stuffed with the same commercial poultry feed to which was added an equal amount of corn-meal (60 gm.

of poultry feed and 60 gm. of corn-meal daily). No water was given other than the content of the wet mash. To the daily stuffing of 4 of these birds, 2 gm. of pure cholesterol was added.

Group IV: Eight geese were fed exactly as those in Group III. In addition, daily intramuscular injections of 2 cc. of the above described extract of the pancreas were administered.

TABLE 1. COMMERCIAL POULTRY FEED.

Contents per ton:	
Alfalfa leaf meal	40 lbs.
Ground barley	100 lbs.
Yellow corn-meal	1140 lbs.
Corn gluten meal	35 lbs.
Dried molasses, ferm., (solution)	40 lbs.
Fish meal	40 lbs.
Meat scrap	25 lbs.
Molasses	40 lbs.
Ground oats	100 lbs.
Soy bean oil meal	247.4 lbs.
Wheat standard middlings	120 lbs.
Calcium carbonate	35 lbs.
Choline carbonate	1.3 lbs.
Dicalcium phosphate	30 lbs.
Iodine salt	5 lbs.
Manganese sulphate	0.5 lb.
Vitamin A and D Feeding (deactivated animal sterole)	3.6 lbs.
Niacin	10 gm.

This feed contains approximately 15.5% protein, 3% fat, 57% carbohydrates, fiber, and minerals.

At the end of ninety days, all geese were sacrificed; all organs and arteries were inspected with a 3X lens. Sections for histopathologic examinations were made from the gross pathologic lesions seen in the arteries and livers. The staining methods used were the hematoxylin-eosin technique and Mallory's aniline blue. Total liver fats and total liver cholesterols were determined. The method used for total fat estimation was the one recommended by the Association of Official Agricultural Chemists (16), while the Bloor, Pelkan, Allen method was employed in the cholesterol determination (3). Because of the comparatively small number of birds, the total liver fats and total cholesterol values were pooled for each group. The weight of the various groups of birds was recorded as were the weights of the livers, hearts, and the omental fat.

The arterial lesions were graded on the basis of their gross and microscopic appearance. The following gradation ranging from 0 to 5 was used:

Grade 1:	Macroscopic:	Injected intima.
	Microscopic:	Cloudy swelling.
Grade 2:	Macroscopic:	Plaque or pin point hemorrhages seen with 3X lens.
	Microscopic:	Hemorrhagic process and lymphocytic infiltration.
Grade 3:	Macroscopic:	Diffuse stain for fat upon merely wiping the artery with sudan IV. Elevation of intima. Narrowing of vascular orifices. Discoloration (areas of hyperemia with yellowish centers).
	Microscopic:	Cellular metamorphosis of the intima or intima and media.
Grade 4:	Macroscopic:	Appearance of large atheromatous plaques, gross vascular obliteration.
	Microscopic:	Thrombus formation and hyalinization. Fibrous proliferation.
Grade 5:	Macroscopic:	Calcific deposits.
	Microscopic:	Calcium deposition as seen upon staining.

RESULTS

Arterial Changes

A summary of the pathologic arterial changes as seen in the four groups of geese is given in table 2.

Group I (farm controls): No pathologic changes were found in this group.

Group II (laboratory controls): Two geese showed grade 1 pathologic change of the aorta (fig. 3).

Group III (force fed animals): The changes in the 4 geese force fed with normal food ranges from grade 1 to grade 4, while the geese which received in addition 2 gm. of cholesterol showed pathologic changes ranging from grade 3 to grade 4. There was narrowing of the

TABLE 2. PATHOLOGIC ARTERIAL CHANGES.

Group	Number of Geese				
	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Group I	8	0	0	0	0
Group II	6	2	0	0	0
Group III					
(a) Noncholesterol-fed	0	1	1	1	1
(b) Cholesterol-fed	0	0	0	2	2
Group IV (treated with pancreatic extract)					
(a) Noncholesterol-fed	2	1	1	0	0
(b) Cholesterol-fed	0	1	2	1	0

man atheromatosis (fig. 11, d). Marked atheromatous plaques were scattered throughout the aorta as well as other vessels, particularly the renal and coronary arteries. Partial and complete obliteration of the vascular lumen were quite common findings, particularly in the cholesterol-fed birds (figs. 4 and 5).

One bird of Group III (force fed without cholesterol) showed a large subendocardial hemorrhage (fig. 11, e). Atherofibrosis, localized hyalinization, intimal changes, and thrombus formation were seen in the walls of the aorta and coronary arteries (figs. 6, 7, and 8). The obliterative phase of the disease in the geese resembled that seen in human atheromatosis (23). The pathologic process was often found just above the bifurcation of the

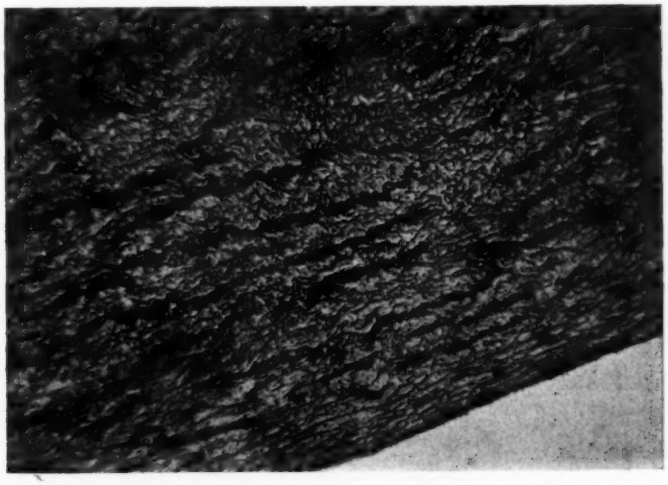

FIG. 3. Cloudy swelling and fibrous changes in the aorta of a laboratory control (fed ad libitum, untreated, and unstuffed) goose. The fibers appear irregular and condensed. The pattern between the elastic fibers is indefinite and loss of continuity occurs. Grade 1. Stained with hematoxylin-eosin. Magnification 100 X.

vascular orifices with discoloration and cellular metamorphosis of the intima and media. Large atheromatous plaques with thrombus formation, hyalinization, and fibrous proliferation were seen in 2 of the cholesterol-fed geese. The birds in Group III showed gross and microscopic pathologic lesions resembling human atheromatosis (fig. 11, d). Marked atheromatous plaques were scattered throughout the aorta as well as other vessels, particularly the renal and coronary arteries. Partial and complete obliteration of the vascular lumen were quite common findings, particularly in the cholesterol-fed birds (figs. 4 and 5).

One bird of Group III (force fed without cholesterol) showed a large subendocardial hemorrhage (fig. 11, e). Atherofibrosis, localized hyalinization, intimal changes, and thrombus formation were seen in the walls of the aorta and coronary arteries (figs. 6, 7, and 8). The obliterative phase of the disease in the geese resembled that seen in human atheromatosis (23). The pathologic process was often found just above the bifurcation of the abdominal aorta. This finding is of interest in view of the fact that it is also a common site of atheromatous lesions in man.

Group IV (force fed geese treated with pancreatic extract): The pathologic changes in the birds force fed with the ordinary diet and treated with pancreatic extract ranged

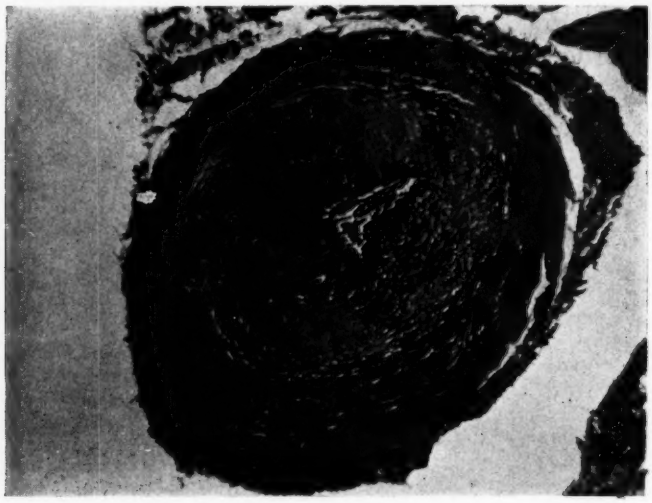

FIG. 4. Coronary artery of a force-fed (ordinary diet plus cholesterol) untreated goose. Almost complete obliteration of the lumen is seen. There is a thickening and cellular infiltration in the arterial coat together with many fat globules. Eosin-hematoxylin stain. Magnification 150 X.

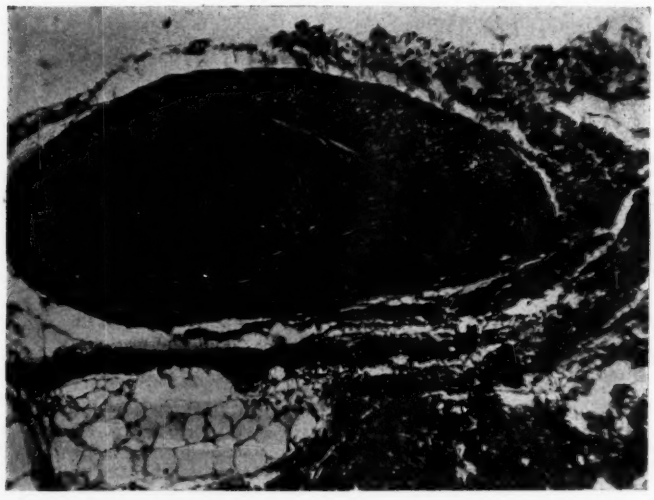

FIG. 5. Another section of a coronary artery of a force-fed (ordinary diet plus cholesterol) untreated goose showing complete obliteration, a hyperplastic sclerosis, with numerous fat droplets in the arterial coats. Eosin-hematoxylin stain. Magnification 150 X.

from grade 0 to grade 3, whereas the cholesterol-fed geese treated with pancreatic extract showed changes from grade 1 to grade 3. Two of the noncholesterol fed birds did not show any pathologic changes, while 1 bird showed cloudy swelling and one bird showed macroscopically pin point hemorrhages and microscopically hemorrhagic processes with

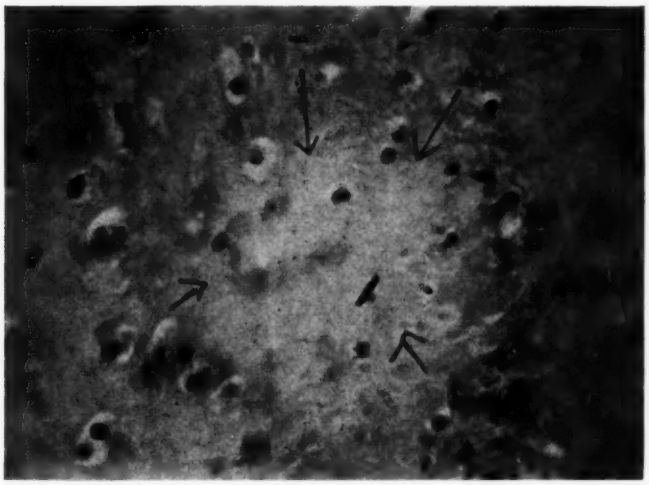

FIG. 6. Coronary artery of a force fed (ordinary diet without cholesterol) untreated goose. Note localized area of hyalinization. The cells are typically chondroid in this microscopic section. Stained with hematoxylin-eosin. Magnification 100 X.

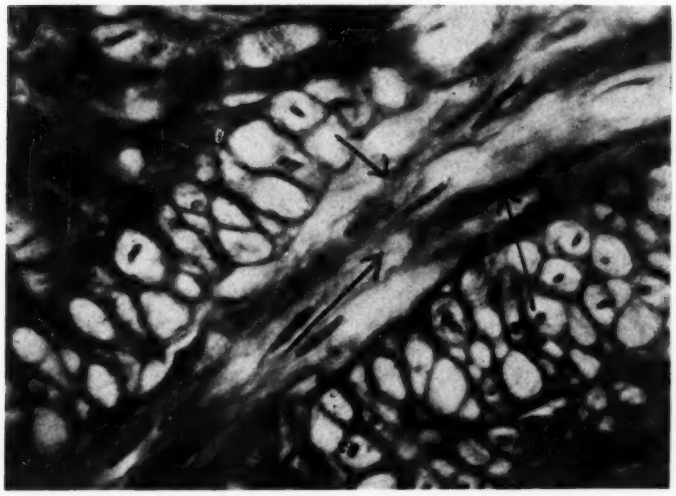

FIG. 7. Goose aorta with thrombus formation in force fed (ordinary diet without cholesterol) untreated bird. Stained with hematoxylin-eosin. Magnification 150 X.

lymphocytic infiltration. The pathologic changes in the cholesterol-fed *and* treated birds were definitely less marked than those seen in the cholesterol-fed untreated geese.

Liver and Weight Changes

Group I: No pathologic changes were found in this group.

Group II: All birds of Group II (confined)

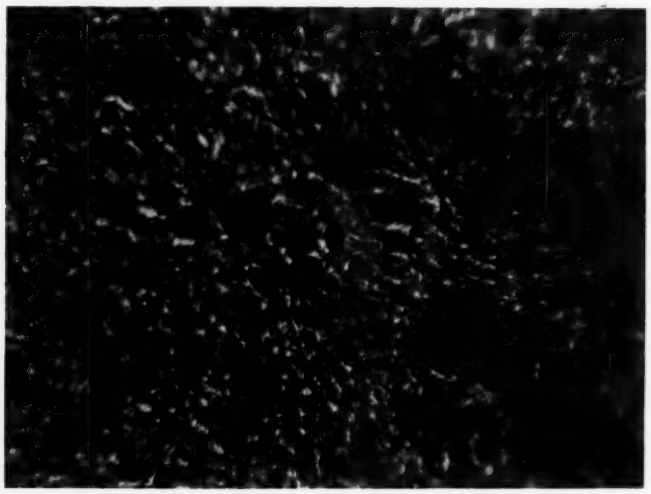

FIG. 8. Goose aorta in force fed (ordinary diet without cholesterol) untreated bird (higher power) showing characteristic foam cells. Stained with Sudan III. Magnification 150 X.

gained more weight than those of Group I (unconfined) (table 3). The organs studied reflected this increase in total body weight. The total liver fat and total liver cholesterol was also slightly higher than found in Group 1 (table 4).

TABLE 3. INCREASE IN WEIGHTS OF HEART AND LIVER IN GROUPS OF GEESE INCLUDED IN THE STUDY.

Group	Average Weight Gain Pounds	Average Weight, Heart Grams	Average Weight, Liver Grams
Group I	3.7	42	75
Group II	5.5	47	81
Group III (Noncholesterol-fed)	8.6	51.2	190
Group III (Cholesterol-fed)	9.9	53	212
Group IV (Noncholesterol-fed *and* treated)	6.4	44.1	92
Group IV (Cholesterol-fed *and* treated)	8.0	48.15	109

Groups III and IV: The birds stuffed with cholesterol in addition to the ordinary diet showed a greater gain in weight (table 3) than those stuffed with the normal diet alone. They also showed higher total liver cholesterol and total fat values than those birds which did not receive cholesterol.

Striking macroscopic (fig. 11, b) and histologic (fig. 9, a and b) changes were noted in the livers of all the untreated overfed geese. In these animals extensive fatty metamorphosis

TABLE 4. WEIGHT OF OMENTAL FAT, LIVER CHOLESTEROL, AND TOTAL FAT VALUES IN GROUPS OF GEESE INCLUDED IN THE STUDY.

Group	Omental Fat Grams	Liver Cholesterol (Average) Mg. %	Total Liver Fat (Average) Grams
Group I	290	108	6.5
Group II	322	121	7.2
Group III (Noncholesterol-fed)	795	290	27.3
Group III (Cholesterol-fed)	908	460	30.7
Group IV (Noncholesterol-fed *and* treated)	390	146	10.7
Group IV (Cholesterol-fed *and* treated)	480	230	18.9

of the liver parenchyma was found with destruction of liver tissue. These changes occurred to a much lesser degree in the livers of the overfed geese treated with an extract of the pancreas (fig. 10, and fig. 11, c).

Discussion

The investigations reported here focus attention on the possibility of a disturbance of lipoid metabolism being an important etiologic factor in the causation of the atheromatous

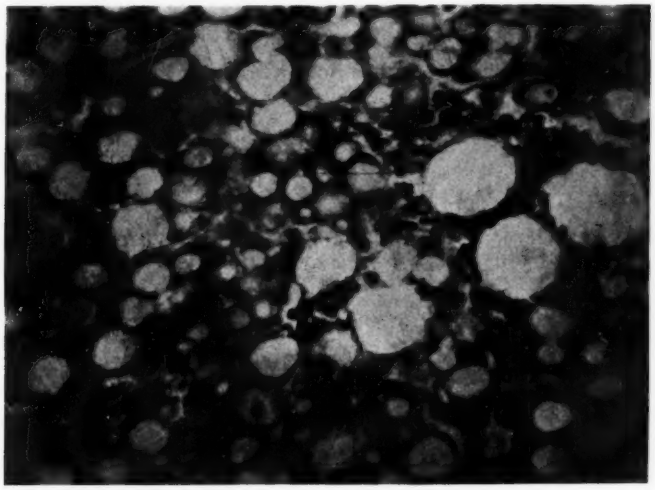

Fig. 9, a. Section of force-fed (without cholesterol) liver of a goose not treated with pancreatic extract. The number of fat spaces in this section are considerably increased and in many areas appeared to completely obliterate much of the normal liver tissue. Stained with hematoxylin-eosin. Magnification 100 X.

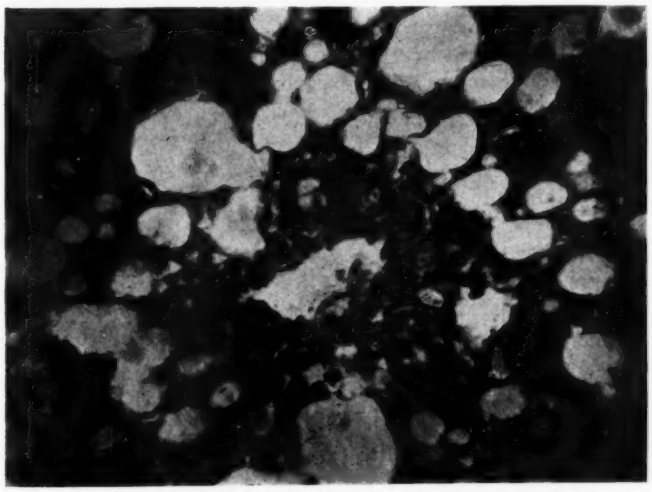

Fig. 9, b. Liver from force-fed (ordinary diet plus cholesterol) untreated goose. Note extensive fatty metamorphosis of the liver structure with destruction of tissue. Stained with hematoxylin-eosin. Magnification 150 X.

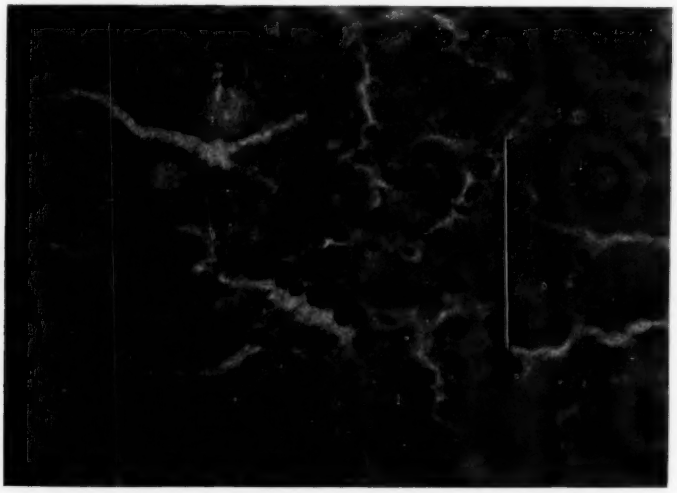

FIG. 10. The number of fat spaces in this section of the liver of a treated (with pancreatic extract) cholesterol-fed goose, although slightly more numerous than those seen in the liver of the control geese, are quite different from the untreated birds. Stained with hematoxylin-eosin. Magnification 100 X.

syndrome. The findings in Group IV provide suggestive evidence of a prophylactic or reversal response if pancreatic extract is administered simultaneously with force feeding and confinement. As yet, however, we have not established from our experiment whether the pancreatic extract prevents atheromatosis and expecially hepato-atherosis by its action on excessive lipid or food intake or on the effects of cholesterol feeding. The protective action may be due in greater part to its effect on other lipoid metabolic factors, rather than on the lesions produced by cholesterol.

Thus, it becomes important to investigate further the effect of the extract from beef pancreas on geese fed pure cholesterol without adding vegetable oils or other fats. Such birds should not be overfed nor kept in confinement. From our experiments to date, it seems evident that any one of these factors (vegetable oils or other fats, overfeeding, and even confinement) may cause the atheromatous syndrome.

SUMMARY

Atheromatous disease can be produced experimentally in geese; the histopathologic picture of these lesions is similar to atheromatosis in humans.

The atheromatosis and especially hepato-atherosis can be produced solely by overfeeding *without* the use of cholesterol. The disease is more severe if cholesterol is added to the diet.

Suggestive evidence is presented that a pancreatic extract administered parenterally to geese with experimentally produced atheromatosis either retards or reverses the pathologic process.

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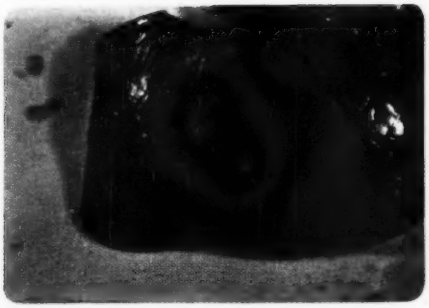


a

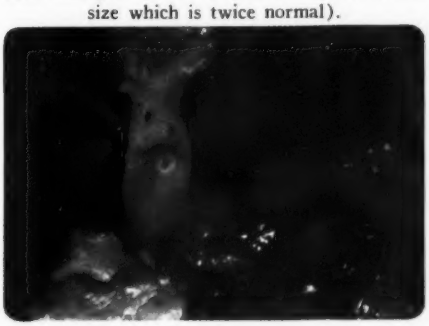
Normal goose liver showing maroon color

b

Liver of stuffed untreated goose; ochre yellow appearance of liver resulting from marked fatty changes. (Picture does not reflect actual size which is twice normal).

c

Liver of stuffed goose treated with polyextract of the pancreas; near normal in color and size.



d

Early atheromatous changes of the aorta in a force fed (ordinary diet plus cholesterol) untreated goose. Note large area of degeneration around the vascular orifice.

e

Spontaneous subendocardial hemorrhage in the left ventricle of a force fed (ordinary diet without cholesterol) untreated goose. Pathologic sections did not show coronary occlusion at this site.

FIGURE 11.

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Degenerative Joint Disease in Mice Fed High-Protein Diets

MARTIN SILBERBERG AND RUTH SILBERBERG

A NUMBER of investigators have stressed the importance of metabolic factors (2, 3, 4, 9, 11) and of aging processes (1, 2, 3, 9, 10, 11) in the pathogenesis of osteoarthritis. Yet only a few experimental data are available to prove or disprove this point of view. Observations on genetically uniform animal stocks became possible when in aging mice spontaneous articular changes resembling those of degenerative joint disease of man were found. In strains of mice susceptible to the spontaneous disorder, the course of these lesions could be modified by the treatment with various hormones (9). In addition, a diet containing 29 per cent lard fed from the time of weaning accelerated skeletal aging and doubled the incidence of osteoarthritis as compared with that seen after feeding a stock diet containing 5 per cent fat (11). On the other hand, a diet containing 53 per cent casein hastened skeletal development without intensifying the aging processes at a commensurate rate (10).

The present report deals with observations made in the skeleton of mice fed protein-enriched diets throughout life.

MATERIAL AND METHODS

One hundred forty-seven male and 26 female mice of the closely inbred strain C57 black, raised in our laboratory, were used. One hundred and six male and 26 female mice of the same strain, fed the stock diet of Purina Laboratory Chow, known as ration B 2362 (diet I), served as controls. Eighty-four animals were fed a high-casein diet (diet II); 63 males and 26 females received a high-protein diet containing fish meat as a source of protein (diet III). The composition of these diets was essentially as shown in table 1.

These rations and water were available to the animals at all times. Since the present investigation was purely qualitative in nature, no attempt was made to control the daily food-intake.

TABLE 1. COMPOSITION OF DIETS.

Components	Diet I	Diet II	Diet III
	Per-centage	Per-centage	Per-centage
Protein	26.18	52.69	45.95
Fat	5.35	2.64	5.65
Fiber	4.62	2.32	3.05
Ash	6.49	3.96	16.81
Nitrogen Free Extract	48.46	29.49	18.37

The necessary vitamins and minerals were added in adequate amounts. Details about the exact composition of diets I and II have been given previously(10). Diet III contained: Fishmeal 66 per cent, oat middlings 10 per cent, soybean oil 3 per cent, dehydrated alfalfa meal 4 per cent, special vitamin premix 0.4 per cent, dried brewer's yeast 4 per cent, steamed bone meal 3 per cent, cooked corn grits 9.6 per cent. The fishmeal contained: Protein 63 per cent, ash 21.5 per cent, fiber 0.5 per cent, fat 5 per cent, water 10 per cent. The special vitamin premix was composed of ergosterol 7.5 per cent, puriflavin 78.9 per cent, thiamin 12.6 per cent, niacin 1.0 per cent.

For the study of growth, 4 mice of each group and sex were sacrificed at the ages of 6 weeks or 2 months, and 6 mice each of each group and sex at the ages of 3, 4, or 6 months respectively. For the study of skeletal aging only male mice were used; these were divided into three age groups.

Age group 1 (9 to 12 months): 36 mice fed diet I; 14 mice fed diet II; 15 mice fed diet III. *Age group 2* (13 to 18 months): 34 mice fed diet I; 24 mice fed diet II; 16 mice fed diet III. *Age group 3* (19 to 24 months): 36 mice fed diet I; 20 mice fed diet II; 6 mice fed diet III.

The weights of the animals were recorded at weekly, and from the age of 6 months on, at monthly intervals. Mice that appeared sick or lost weight were sacrificed prematurely or discarded. Since the diets were well tolerated, the majority of the animals could be killed according to plan. At necropsy, tibiae and femurs were removed as a whole, fixed in Bouin's solution, embedded in paraffin, and semiserial sections were stained with hematoxylin and eosin for microscopic studies.

Gross Observations

Gain in weight was steady, and the deviations from the means in the animals fed the experimental diets were insignificant. The mean weights of the animals fed the test and experimental diets are shown in figure 1.

The course of the weight curves was similar in all groups, except that the weights of the animals receiving the protein-enriched diets remained slightly below that of the controls for most of the first 18 months of life. Thereafter, the weights of the test animals failed to show the decline in weight occurring in aging animals fed the control diet. From the age of 12 months on, mice receiving the fish-protein showed a better gain in weight than those receiving the casein. Irrespective of the diet consumed, the females gained weight more slowly than the males.

Microscopic Observations

Epiphyseal Growth: During the first months of life, epiphyseal development was more rapid in the female than in the male. Moreover, in mice receiving the fish-protein, epiphyseal development was faster than in the group receiving the casein diet. The rapid development was indicated, in particular, by an accelerated conversion of the columnar into hypertrophic cartilage cells and a hastened replacement of the latter by bone. Further details may be found in a previous publication (10).

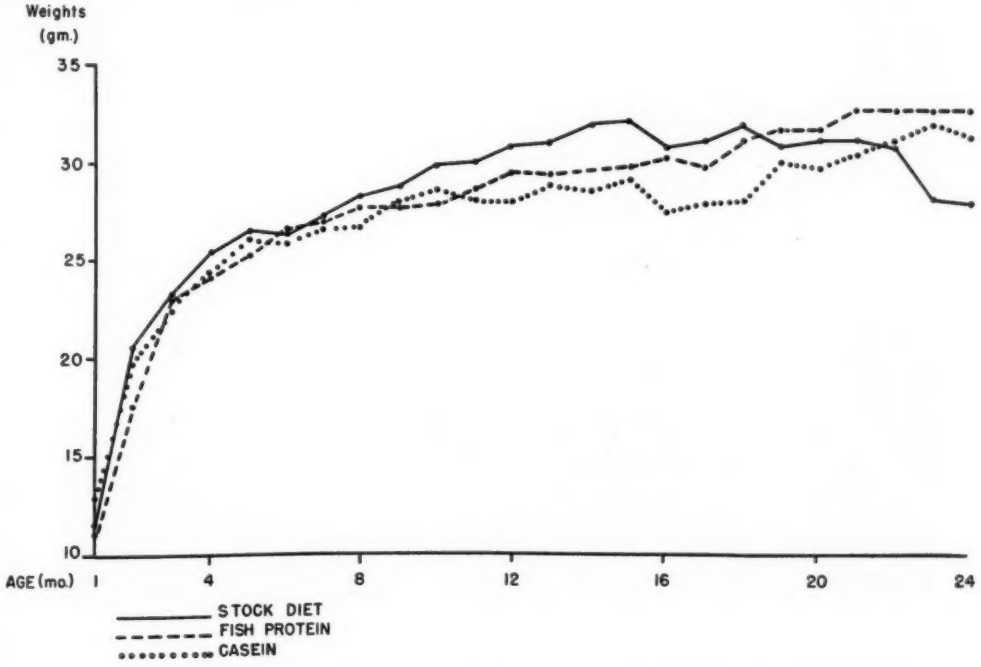

Fig. 1. Mean weights of the mice fed the stock, fish-protein, or casein diets respectively.

Articular Findings: The conditions in the joints were graded. *No Change* is characterized by a smooth articular surface, by regular configuration and spacing of the small cartilage cells rows and by uniformly eosinophilic ground substance (fig. 2). *Age Changes* may vary in degree: Slight changes consist of some hyperplasia and hypertrophy of the cartilage cells, while a stain with hematoxylin and eosin fails to disclose alterations of the matrix; there may be focal proliferation of synovial tissue with ingrowth of the latter into the epiphyseal bone marrow; the joint surface, however, remains smooth, and the articular cartilage cells retain their usual arrangement. Advanced age changes manifest themselves in focal or diffuse hyperplasia and hypertrophy of the cartilage associated with regressive changes in cells and ground substance: At the periphery of the cells basophilic rims appear, or the nuclei become hyperchromatic; the matrix shows swelling, roughening or fibrillation; there are irregularities of the articular surface; the synovial tissue and the ligaments may likewise proliferate and undergo regressive change. *Osteoarthritis* is characterized by a combination of growth processes and regressive changes leading to articular deformities varying in degree: Hypertrophic marginal outgrowths or articular ulcers with condensation and eburnation of the floor may be seen; again, synovialis and ligaments may be involved. (figs. 3 to 5).

Table 2 allows a comparison of the articular findings in the animals fed the control and the test diets respectively.

Control series: Articular lesions were more frequent in the animals of the older than in those of the younger age groups: Unaltered joints were found in 22.2 per cent of mice 9 to 12 months old with a mean age of 10.2 months, but only in 5.6 per cent of mice 19

FIG. 2. Knee joint: The upper end of the tibia and the lower end of the femur, both menisci and the joint capsule, are seen. The tissues show regular architecture. (No change). Magnification 55x.

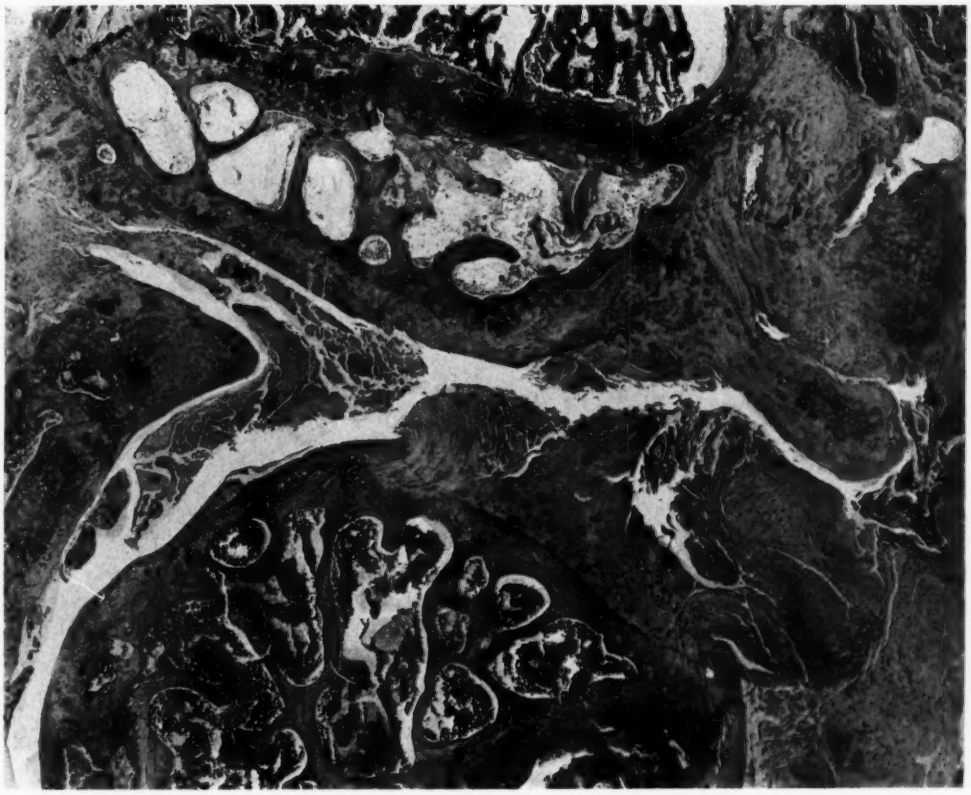

FIG. 3. Knee joint: Roughening and fibrillation of the cartilaginous matrix with focal proliferation of the articular cartilage at the lower end of the femur and the upper end of the tibia. (Advanced age change and early degenerative joint disease). Magnification 55x.

to 24 months old with a mean age of 22.2 months. Conversely, age changes were present in 69.5 per cent of the mice 9 to 12 months of age, and in 38.8 per cent of those 19 to 24 months old. The apparent drop in the incidence of age changes observable with advancing age could be accounted for by the increasing incidence of the severe osteoarthritic lesions. While of the animals 9 to 12 months old with a mean age of 10.2 months only 8.3 per cent had degenerative joint disease, these lesions were increased almost seven times (55.6 per cent) in mice 19 to 24 months old with a mean age of 22.2 months. The mean age of all control mice irrespective of the age groups was 14.2 months; the total incidence of osteoarthritis was 32.1 per cent, 54.7 per cent of the animals showed age changes of varying degree, and 13.2 per cent unchanged joints.

Test series: In the animals fed the high-protein diets, the incidences of age changes as well as of osteoarthritic lesions showed the same trend—towards an increase with advancing age—as they did in the control series. However, in the test series both age changes and osteoarthritis were less frequent and set in later than in the controls.

High-casein diet: The incidence of articular age changes rose from 42.9 per cent at about 12 months of age to 58.4 per cent, and the incidence of uninvolved joints dropped from

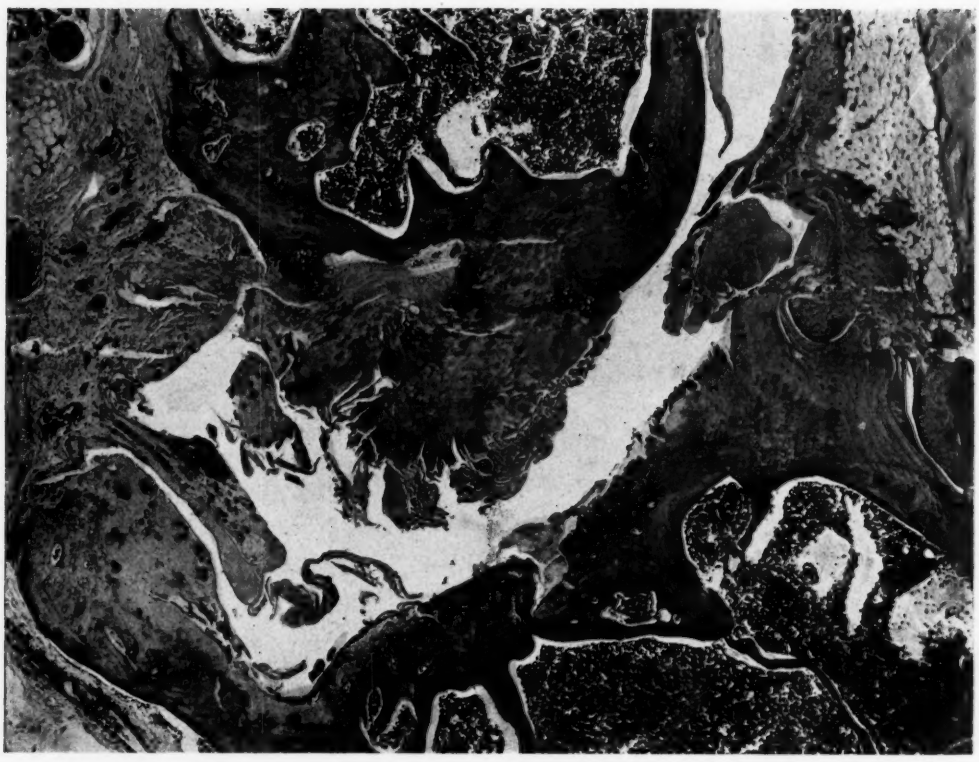

FIG. 4. Knee joint: Advanced growth processes and regressive changes of the articular cartilage with marginal osteoarthritic outgrowth. Magnification 55x.

22.2 per cent at the end of the first year of life to 11.8 per cent, as the mice approached the age of 18 months. In mice nearing the end of the second year of life, the incidence of unaltered joints dropped to 5 per cent, whereas that of osteoarthritic lesions rose from 14.2 per cent at the mean age of 11.9 months to 20.8 per cent at the mean age of 17.8 months and to 45 per cent at the mean age of 22.7 months.

Fish-protein: The trend was similar to that observed in the animals fed the high-casein diet: Unaltered joints were present in 40 per cent of the mice sacrificed at the age of 12 months and in 31.2 per cent of the mice living to the mean age of 16.1 months; unaltered joints were not seen in the oldest age group of this series. However, the small number of mice in this group is probably not truly representative. The incidence of simple age changes remained fairly constant—between 50 per cent and 60 per cent—in all groups, with a definite trend towards an increased incidence of osteoarthritis in the old age groups. The incidence of osteoarthritic changes rose from 0 per cent at the end of the first year of life to 18.8 per cent at the age of about 18 months and to 33.3 per cent at the end of the second year of life.

The tendency to a delayed onset and a decreased incidence of articular changes in mice fed the high-protein diets as compared with that seen in mice fed the control diet becomes obvious from the data of the last horizontal column of table 2; in this column the articular findings are given for all animals regardless of their age at death. Of all the control mice 13.2 per cent had unaltered joints and

FIG. 5. Knee joint: Osteoarthritic ulcers at the articular surfaces with eburnation of the floors and remnants of hyperplastic cartilage at the margins. Magnification 55x.

32.1 per cent had osteoarthritic lesions. In mice fed the fish-protein, this ratio was practically reversed, 29.8 per cent having unaltered joints and 13.5 per cent degenerative joint disease. The comparatively large number of mice fed the high-casein diet and showing osteoarthritis (27.6 per cent) is probably due to the fact that the mean age at death of these mice (19.8 months) was considerably higher than that of the groups fed the fish-protein (15.7 months) or the control diet (14.2 months) respectively.

DISCUSSION

In male mice of strain C57 black, fed diets containing 53 per cent casein or 46 per cent fish-protein, respectively, epiphyseal development was accelerated as compared with conditions in animals fed the control diet containing 26 per cent protein. This effect was more marked than that previously observed in females of the same strain (10). Mice thus respond to protein-enriched diets in a similar way as do rats (5, 6, 7, 8). Under the influence of the high-protein diets, articular aging and the onset of degenerative joint disease were delayed as compared with the course of these processes in mice fed the control diet. The experimental findings thus support the clinical view (2, 3) that consumption of a high-protein diet has no harmful effect on aging of articular tissues. The results are, however, in marked contrast to the adverse effect on the joints brought about in mice of

TABLE 2. ARTICULAR FINDINGS IN MALE MICE OF STRAIN C57 BLACK FED THE CONTROL, CASEIN, OR FISH-PROTEIN DIETS.

Age Group (Months)	Type of Diet	Number of Mice	Mean Age of Mice (Months)	No Change Percentage	Age Changes Percentage			Osteoarthritis Percentage
					Slight	Advanced	Total	
9-12	Control	36	10.2	22.2	58.4	11.1	69.5	8.3
	Casein	14	11.9	42.9	28.7	14.2	42.9	14.2
	Fish-protein	15	12.0	40.0	53.3	6.7	60.0	0.0
13-18	Control	34	16.8	11.8	49.9	5.9	55.8	32.4
	Casein	24	17.8	20.8	33.3	25.1	58.4	20.8
	Fish-protein	16	16.1	31.2	43.8	6.2	50.0	18.8
19-24	Control	36	22.2	5.6	27.7	11.1	38.8	55.6
	Casein	20	22.7	5.0	25.0	25.0	50.0	45.0
	Fish-protein	6	23.8	0.0	33.4	33.3	66.7	33.3
Irrespective of Age	Control	106	14.2	13.2	46.0	8.8	54.7	32.1
	Casein	58	19.8	20.7	29.3	22.4	51.7	27.6
	Fish-protein	37	15.7	29.8	45.9	10.8	56.7	13.5

the same strain by the consumption of a high-fat diet (11).

There seems to be a close positive correlation between the course of early articular age changes and the appearance of degenerative joint disease: In mice of strain C57 black fed a fat-enriched diet, both the onset of articular age changes and of osteoarthritic lesions were advanced by several months, the rate of acceleration being about the same for the simple age changes and degenerative joint disease. The results of our experiments with the high-fat diet as well as the protein-enriched diets thus indicate that factors acting on tissues early in life may exert a profound effect on the course of tissue changes appearing only with advancing age.

The mechanism by which the high-protein diets accomplish the retardation of articular aging is unknown. Protein storage occurs in growing but not in adult individuals. Therefore, a protein-enriched diet is liable to produce most marked effects during the growth period. However, even in adult individuals, indirect effects may become operative possibly through the mediation of other phases of metabolism. The metabolism of minerals may somehow be involved: Carcasses of rats fed protein-enriched diets contain less calcium than corresponds to their age (7, 8). Still no link can as yet be established between these observations and ours concerning the articular tissues. However, it may be noteworthy in this respect that the two high-protein diets fed to our mice differed in their ash content, the fish-protein diet containing about four times as much as the casein diet and about three times as much as the control diet. It is, therefore, improbable that a relative calcium deficiency may account for the retardation of articular aging in mice fed the protein-enriched diets. Further investigations will have to clarify these problems.

SUMMARY

In growing mice of strain C57 black fed diets containing 53 per cent casein or 46 per cent fish-protein from the time of weaning, skeletal development was accelerated as compared with conditions seen in animals of the same strain fed a stock diet containing 26 per cent protein. Males responded more readily than females to the change in the dietary regimen.

Articular aging was retarded and the onset of degenerative joint disease was delayed in the mice fed the protein-enriched diets. These results are in marked contrast to those obtained by feeding a fat-enriched diet, which caused an acceleration of skeletal aging and an increased incidence of degenerative joint disease.

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Population Erosion and Population Vigor Among Unicellular Organisms

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From time to time various observers have noted a gradual loss of vigor and final death of serial culture populations of unicellular organisms. The unexpected extinction of an entire population under conditions which previously had maintained the strain or clone in a state of health and vigor was difficult to explain.

In the light of our experience in the study of survival mechanisms among single-cell species and the observations of previous investigators, this process of extinction is designated herein as "population erosion." Our own observations have shown that under certain imposed environmental conditions a gradual deterioration of the growth and cell-division potential and a final extinction of all individuals in the terminal population of a series occurs.

However, there is no definite evidence as yet that we are observing a genuine genotypic erosion. What we have shown is that certain environments to which serial cultures of several different species are subjected may be apparently harmless (ontogenetically) and even stimulating to individuals at first, but in the course of time, will be lethal (phylogenetically) to the population as a whole. In other words, the activity and vigor of individuals does not necessarily reflect the vigor and the potential survival value of the clone. The exact mechanism of "population erosion" is not known but it is obvious that the process of cell-division is finally interfered with and complete infertility and death of the entire population or clone results.

Examples of Population Erosion

In 1933, Casman and Rettger (2) attempted to acclimatize certain well-known members of the subtilis group of bacteria to high temperatures. Cultures were transferred daily in broth and on slant agar for about one year and incubated at the maximum growth temperature for each organism. The 8 species tested revealed "practically no ability to adapt themselves to temperatures of growth above their already established maximum . . . Cultures frequently died out during the treatment." The authors did not attempt to explain the death of these bacterial populations. In the light of our experience, however, this population death would not have taken place if an *interval* exposure rather than a *continuous* exposure to the high temperature had been imposed upon these serial cultures. We have found that under conditions of continuous exposure, population death may not take place in the early transfers, but an injury to the reproductive or cell-division mechanism often manifests itself only after many serial culture transfers.

It seems reasonable to assume that this population extinction observed by Casman and Rettger was due to a cumulative injury to either the cytoplasmic or genic substance of cells despite no visible effects on phenotypes or individuals in the early cultures of the series. The final death of the population series seemed to be, in effect, a delayed response to the continuously high temperature.

In 1942, Hegarty and Randall (3) also observed an example of "population erosion" but explained the result on the basis that their technique obliterated the lag phase of growth. By serially transferring *Escherichia coli* every four hours at 37 C. by platinum loop in nutrient broth tubes (thus keeping the organisms in the logarithmic phase of growth and obliterating the lag phase) these investigators found that the strain died out after the forty-second

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transfer. After the thirtieth transfer the culture went into a spontaneous lag phase, from time to time, within the four-hour transfer period. Yet it was concluded that "the lag phase was a rejuvenating process as originally suggested by Sherman and that it was necessary for the continued growth of a bacterial culture." This result is, we believe, another example of "population erosion" despite the fact that the populations were at all times kept in the presence of an ample food supply and at the optimum growth temperature (37 C.). But because of the rapid four-hour transfers the culture populations were never permitted to mature or age before the next serial transfer was made. Thus, the successive generations of organisms were kept continuously in an actively multiplying phase. Such conditions placed the burden of maintaining the continuity of serial-culture populations always upon the cells of young populations. Our experience suggests that a certain degree of maturity of cell populations, which permits the elaboration and accumulation of metabolites and other substances, is more likely the factor "necessary for the continued growth of a bacterial culture" than a rejuvenation by the lag phase.

We attempted to repeat this experiment with a strain of *E. coli* that forms a heavy pellicle within twenty-four hours. On a four-hour loop transfer rhythm in serial tryptose phosphate broth tubes this strain lived for 72 transfers when the test was discontinued. However, employing a three-hour transfer rhythm at 40 C., it survived for 15 transfers and died on the sixteenth. A definite turbidity was observed within three hours in the first 7 transfers and the absence of turbidity or lag for seven to eight hours from the eighth to the fifteenth transfer, failing completely to grow on the sixteenth transfer. Thus, within limits, the results of Hagerty and Randall were confirmed. A slow population erosion and final death was demonstrated.

Jennings (4) working with *Paramecium bursaria* found that clones of this species like individual bodies in multicellular forms passed through a period of sexual immaturity followed by a period of sexual maturity, lasting several years and then a period of decline (aging) during which multiplication was slower and the death of individuals became frequent. Finally the clone died out completely. Jennings apparently did not arrive at any satisfactory explanation of the death of his clones but stated that the sequence of youth, maturity, senescence, and death of populations was not unlike that observed in all multicellular individuals. These higher forms of life are, in effect, cell aggregates or cell populations that are better organized than free-living unicellular organisms. However, even colonies of bacteria on solid media often reveal an organization more or less characteristic of the species.

Working with another species of paramecia *(P. multimicronucleatum)* we were able to demonstrate that serial culture populations may be slowly eroded or exhausted in two or three years by means of a continuous exposure to small amounts of various chemicals (7). At the same time our 6 untreated control population-series, even though they were under ideal laboratory conditions that were optimum from the standpoint of temperature, food supply, and freedom from enemies, passed also through the stages described in the earlier work of Jennings and finally died out after living seven to nine years. Although certain populations of paramecia undoubtedly die out from time to time in nature when confined to some specific environmental niche, others have survived indefinitely since they may be recovered at any time from fresh water ponds or streams.

Just what the factors are which bring about the final extinction of serial cultures of paramecia in the laboratory under apparently ideal conditions is not known, but it seems reasonable to assume that there must be a slow step-like mechanism which results finally in an exhaustion of the clone.

We have also studied the effect of various environments on serial-culture populations of a multicellular flat worm *(Stenostoma tenuicaudatum)* (1). When a serial-culture popula-

tion of these worms was exposed continuously to phenanthrene (1 γ per milliliter of medium) and transfers made every fourteen days, the series died out on the ninth transfer (126 days). Another population series exposed to the gamma rays of radium (35 mg.) in platinum-iridium needles died on the thirty-second transfer (490 days). The control untreated population series lived for 57 transfers, or more than two years, at which time it was discontinued.

The aging and death of serial populations of rotifers has been reported by Lansing (5). In this multicellular animal that reproduces sexually but whose ova develop parthenogenetically, the method used was to select through a series of generations the ova from uniformly young or uniformly old parents. Such serially selected lines were called "orthoclones." Old orthoclones (geriaclones) showed a decrease in mean life span as compared to the parental stock and all old orthoclones became extinct after a limited number of generations. Young orthoclones (pediaclones), on the other hand, maintained an increased life span through a series of generations.

These experiments by various investigators in various laboratories on serial-culture populations of bacteria, paramecia, and certain multicellular forms, reveal a common pattern of behavior. The results suggest unmistakably that the health and vigor of individual organisms or phenotypes do not necessarily reflect the survival value of the population as a whole. Thus, individual health is not synonymous with population health, and in the study of populations it is necessary to keep this distinction in mind.

Induction of Population Vigor

We have reported elsewhere (6) that an alternating or rhythmic exposure of bacterial serial-culture populations to a high temperature (thus providing periods of rest or freedom from the high temperature) insures survival. This is in marked contrast to the early extinction of a series of populations whenever exposed continuously to a high temperature of the same intensity.

In figure 1 five series of culture populations of *Salmonella typhosa* were exposed rhythmically to 45 C. for 118 transfers employing .5 cc. inoculum for each transfer. The odd-numbered cultures in the series were incubated for two days at 45 C. and the even-numbered cultures were incubated at 37 C. After this rhythmic exposure, all 5 tubes of the one hundred nineteenth transfer were placed at 45 C. continuously and not transferred rhythmically subsequently. At the end of each week of the continuous exposure, however, each culture was tested for the presence of live organisms by loop transfers to fresh broth tubes. All were found to be alive after ten weeks' continuous exposure to 45 C.; all were Gram negative rods and yielded the typical fermentation reactions of *S. typhosa*. No later survival tests were made. Five normal control cultures which had not received a rhythmic exposure did not survive 45 C. two weeks. Only 1 culture survived one week.

A similar test was carried out on *Escherichia coli* as seen in figure 2. Five series of cultures were exposed rhythmically for 122 transfers and then placed continuously at 47 C. which is 2 degrees above the temperature to which they were rhythmically exposed. Nevertheless, 3 of the 5 survived seven weeks while not one of the 5 normal controls survived one week.

These tests have recently been repeated and over 200 transfers (400 days) were required to show clear-cut evidence of increased resistance to heat, which was apparent after 122 transfers in our first tests. We attribute this disparity to normal biologic variations. Another example of variation in the ability of culture series to adapt to heat will be noted in figure 2. Two of the 5 series tested did not reveal any resistance, although all had been derived from the same original culture.

By actual counts we demonstrated readily that in the early cultures of the series, no increase in populations had taken place in the alternate tubes exposed to heat as they were removed from the 45 C. water bath. How-

STUDIES IN SURVIVAL

S. TYPHOSA

STERILE BROTH TUBES INOCULATED WITH .5 ML. EACH OF 24 HR. OLD CULTURES AND INCUBATED CONTINUOUSLY AT 45° C.

GROWTH OF LOOP TRANSFERS AT WEEKLY INTERVALS DURING EXPOSURE

DATE		JUNE 21	28	JULY 5	12	19	26	AUG. 2	9	16	23
TRANSFERS		1	2	3	4	5	6	7	8	9	10
NORMAL S. TYPHOSA CONTROL SERIES	1	O	O								
	2	O	O								
	3	O	O								
	4	O	O								
	5	+	O								
ADAPTED TO 45° C. FOR 118 TRANSFERS (T-36)	1	+	+	+	+	+	+	+	+	+	+
	2	+	+	+	+	+	+	+	+	+	+
	3	+	+	+	+	+	+	+	+	+	+
	4	+	+	+	+	+	+	+	+	+	+
	5	+	+	+	+	+	+	+	+	+	+

JUNE 14, 1949 O=NO GROWTH; + = GROWTH

FIGURE 1.

ever, in the heated cultures of the latter part of the series, an increase in population was observed during the heating periods and could be seen grossly as an increase in turbidity. In such serial culture populations exposed rhythmically to high temperatures, two processes are synchronized, namely, 1) the selective elimination of those forms whose genetic pattern is such that they cannot survive the high-temperature environment, and 2) the selective survival of other forms that obviously do survive. When these processes are repeated indefinitely in serial-culture populations, the step-like induction of populations resistant to heat can reasonably be expected in due time.

The biologic mechanism involved in the induction of these heat resistant populations is probably a speeding up of the rate of normally occurring mutations, followed by a selection of heat resistant forms. In subsequent generations or subsequent populations a mutation of these mutations occurs. Biochemically, one can assume that each mutation is a slight but definite step-like physico-chemical heritable change in a gene, in a group of genes, or in a certain pattern of genetic components.

It should also be obvious that a population displaying vigorous growth in a high-temperature environment yields no information as to its behavior or survival value in some other environment. Therefore, the terms population erosion and population vigor apply only to specific genotypes in specific environments.

DISCUSSION

Do these studies of the behavior of populations of small organisms throw any light on the problems encountered in human populations? No one can say. However, public health and medical practice has increased mod-

STUDIES IN SURVIVAL

E. COLI

STERILE BROTH TUBES INOCULATED WITH .5 ML. EACH OF 24 HR. OLD CULTURES AND INCUBATED CONTINUOUSLY AT 47° C.

GROWTH OF LOOP TRANSFERS AT WEEKLY INTERVALS DURING EXPOSURE

DATE		JUNE 29	JULY 6	13	20	27	AUG. 3	10	17
TRANSFERS		1	2	3	4	5	6	7	8
NORMAL E. COLI CONTROL SERIES	1	0							
	2	0							
	3	0							
	4	0							
	5	0							
ADAPTED TO 45° C. FOR 122 TRANSFERS (C30)	1	0	0						
	2	+	0						
	3	+	+	+	+	+	+	+	0
	4	+	+	+	+	+	+	+	0
	5	+	+	+	+	+	+	+	0

JUNE 22, 1949 0 = NO GROWTH; + = GROWTH

FIGURE 2.

ern man's life expectancy to a remarkable degree. Today there are greater numbers of individuals than ever before who are living useful and happy lives in the seventh and eighth decades. As everyone knows, this is largely because of the postponement of death from the communicable diseases in early life, and therefore the sciences of gerontology and geriatrics are focusing attention upon the biophenomena of old and aging individuals, the treatment of their maladies, and the prolongation of their lives; in other words, upon the health and welfare of phenotypes. Not enough thought has been given as yet, in our opinion, to the health and welfare of the population as a whole or to genotypes.

Our studies and those of others show conclusively that in the populations of unicellular species, environmental factors that are apparently favorable to individuals are not necessarily favorable to the welfare and survival value of the population as a whole. However, we do not intend to imply that our interpretations of these observations can be applied to human populations. Nevertheless, in every field of biology in which we attempt to exercise control whether it be farm stock or plants for human food, or whether it be fruit-flies or paramecia for experimental purposes, the quality of the stock must be considered. Therefore, we believe that sooner or later gerontologists must face the problem of genotypic as well as phenotypic welfare.

SUMMARY

1. Population erosion and final exhaustion and extinction can be induced experimentally in unicellular organisms by the *continuous* exposure of serial culture populations to an unfavorable environment.

2. The same phenomenon has been shown to occur also under conditions that are optimum for the growth and cell-division of individuals (phenotypes).

3. On the other hand, population survival, vigor, and adaptation can be induced in unicellular organisms by a *rhythmic* exposure of serial-culture populations to the same environment that is lethal when applied continuously.

4. Since there are more species extinct than extant, these observations naturally stimulate the speculations as to what part "population erosion" has played in the disappearance of species and whether or not it can be detected and to what extent prevented in higher orders of life.

5. Attention is invited to the possible meaningfulness of these experimental results to the gerontologist, the geriatrician, and the public health physician.

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Age Differences in Respiration of Guinea Pig Tissues

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THE enzymatic changes involved in the process of aging have been of much interest. As pointed out by Reiner (6) the simplest to study are the enzymes concerned with carbohydrate metabolism in view of the considerable amount of knowledge available concerning them (1, 2, 4, 5, 8, 10). Reiner (6) used brain and liver tissue of rats in determining the effect of age on the carbohydrate metabolism of tissue homogenates. We thought it of interest to investigate the respiratory rate of guinea pig liver as well as kidney tissue of animals of various ages and to determine the differences, if any, among the age groups when metabolizing a normal substrate, such as glucose in buffered Ringer (9) phosphate solution.

METHODS

For the determination of the oxygen uptake, Warburg's direct method was employed, using standard respiratory flasks with single side-arm and center-well.

The animals from each group, (a) young—up to 8 weeks old, (b) middle-aged—from 50 to 52 weeks old, and (c) aged—100 weeks old, were rendered unconscious by a sharp blow applied to the rear of the head. They were then rapidly bled to death by severing the jugular veins. Both kidneys and the liver were removed and placed in ice-cold Krebs-Ringer-Phosphate solution (9), buffered to a pH of 7.4, containing 0.2 per cent glucose. Any organ which gave gross appearance of being pathologically changed was discarded.

A brei was prepared of each organ by homogenizing the tissue for a hundred seconds in a Waring blender with 30 cc. of Krebs-Ringer-Phosphate made up as described previously. Two cc. of brei were pipetted into the outer well of the Warburg flask, and 0.2 cc. of 20 per cent KOH was added to the center well with a piece of folded filter paper to absorb eliberated CO_2. The flasks were then attached to the manometers and allowed to come to equilibrium with the bath at 37.5 C. for ten minutes before the taps were closed.

A period of 50 $\pm$ 5 minutes elapsed from the time of death of the animal to the first reading after equilibration. Further readings were made at fifteen minute intervals. The number of milligrams of dried tissue per flask was determined by placing a 2 cc. aliquot of the stock brei in an oven at 90 C. over night and weighing, while the number of milligrams of nitrogen per flask was determined by the method of Hiller, Plazin, and Van Slyke (3) on another 2 cc. aliquot. The values obtained for the amount of dried tissue were corrected for the weight of the salt derived from the buffered substrate. Triplicate determinations were carried out for each sample, with the average of the 3 being used for the computation of Q_N and Q.

RESULTS

The results of the experiments are shown in table 1 where the oxygen uptake per milligram of tissue nitrogen (Q_N) is reported. It will be seen that the metabolic rate falls from 18.61 microliters for homogenates of young kidneys to 7.44 for the kidney preparations of aged animals. This represents a drop of over 60 per cent. In contrast to this the oxygen consumption by homogenates of liver varies only slightly with age, showing a maximum in the middle-aged group. Determinations of the oxygen uptake of the homogenates calculated on the basis of milligrams of dried tissue show findings of essentially the same nature.

TABLE 1. THE EFFECT OF AGE ON THE OXYGEN CONSUMPTION OF KIDNEY AND LIVER HOMOGENATES FROM GUINEA PIGS.

	Young (8 Weeks)		Middle-Aged (50-52 Weeks)		Aged (100 Weeks)	
	Q_N	Q	Q_N	Q	Q_N	Q
Kidney Homogenates						
Mean	18.61	4.06	11.04	1.42	7.44	1.15
s. d.	8.35	2.71	3.73	0.60	2.82	0.26
N	9	9	10	18	12	15
Liver Homogenates						
Mean	7.87	1.14	8.64	1.11	7.00	0.97
s. d.	1.76	0.17	3.25	0.44	1.95	0.28
N	10	10	10	19	10	15

Q_N—Microliters of oxygen uptake per milligram of tissue nitrogen per hour.

Q—Microliters of oxygen uptake per milligram of dried tissue per hour.

s. d.—Standard deviation.

N—Number of animals.

In order to ascertain whether the differences which we found for the various age groups were significant, standard statistical methods were used for the computation of the reliability of the differences between the means (7), as shown in tables 2 and 3. If one considers that a value of 2.8 assures virtual certainty that the differences which were found were not due to chance, it can be seen that the age differences in Q and Q_N in the case of the kidney are truly significant. However, in contrast to this no significant difference between the rate of respiration of the various age groups was found for liver homogenates.

Our work has not progressed sufficiently for us to offer any explanation of the phenomena.

SUMMARY

The respiratory rate of guinea pig and kidney tissue was determined in animals of various ages. Warburg's direct method was employed to measure the oxygen uptake of the guinea pig tissue. Our results indicated that the metabolic rate fell from 18.61 microliters of oxygen uptake per milligram of tissue nitrogen per hour for the kidneys of the young animals to a low of 7.44 for aged guinea pig kidney tissue. This represents a drop of over 60 per cent. However, in the case of liver tissue it was noted that the values changed but slightly, showing a maximum in the middle-aged group.

TABLE 2. RELIABILITY OF DIFFERENCES IN MEANS FOR $Q_N \left(\frac{M_1 - M_2}{\sigma M}\right)$

Organ	Young vs. Old	Young vs. Middle-Aged	Middle-Aged vs. Old
Kidney	3.64	2.34	2.57
Liver	1.05	0.63	1.33

TABLE 3. RELIABILITY OF DIFFERENCES IN MEANS FOR Q $\left(\frac{M_1 - M_2}{\sigma M}\right)$

Organ	Young vs. Old	Young vs. Middle-Aged	Middle-Aged vs. Old
Kidney	3.02	2.72	3.81
Liver	1.80	0.93	0.18

M_1—Mean of the first group.

M_2—Mean of the second group.

σM—Standard deviation of means.

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Age Differences in Performance Decrement with Continuous Work

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THE literature is rich in studies of work decrement but relatively little has been done to evaluate age differences in decrement function. Those studies that have considered age as a variable have suffered from a small number of cases (1, 11, 24), or have utilized too limited an age spread (13, 15). If decrement is related to age it becomes important to consider the portion of the decrement curve where age comparisons are made. The determinations of age differences in performance decrements may be valuable contributions to studies on aging, to clinical evaluation of the elderly, and to personnel placement.

Previous studies, utilizing time score indices, have described age differences for the functions of speed of writing (6) and rate of addition (7). The task materials found to be useful in measuring performance changes with age were also suitable for describing decrement with continuous work. At the expense of possibly reducing manifested decrement (10, 19, 21, 25) and of precluding the possibility of curve fitting, the experimental design was such as to use several short tasks of varying difficulty and complexity. The limitations imposed by this design were for the purpose of making the test situation more attractive to the subjects and to indicate possible relationships between age, task difficulty, work interval, and work decrement. The limitations might be large in definitive studies on work decrement, but this study was exploratory. Its purpose was to determine if age differences exist in performance decrement.

PROCEDURE

Subjects.—A total of 100 subjects was secured from the staffs of the Baltimore City Hospitals, from the patients of the Hospitals, and from the residents of the Baltimore city home for the indigent aged. Patient case histories were reviewed in order to reject individuals whose disorders were of such nature that test performance might be affected, e.g., previous history of psychoses or neurologic diseases. The 100 subjects were divided into 2 groups; 50 subjects 20 to 29 years, and 50 subjects 60 to 69 years. All subjects were white, of both sexes, were born in English-speaking countries, and had a minimum of four years of formal schooling. The younger population, however, had more formal education than did the older. The mean years of education for the younger population was 13.61, $\sigma = 2.48$, and for the older population the mean education was 6.85 years, $\sigma = 2.34$.

Materials.—Six tasks involving speed of responses were individually administered to subjects of both populations. The tasks in order of administration were speed of (a) writing digits and (b) writing words (6), addition (7) of (c) 3 digit, (d) 6 digit, (e) 9 digit problems, and (f) digit substitution in the subtest of the Babcock-Levy Scale, the Revised Examination for the Measurement of Efficiency of Mental Functioning (2). Although the tasks were administered as one continuance test, each task was preceded by a minimum time lapse of two to ten seconds since each task was on a different sheet of paper. The task, speed of writing digits, was divided by a similar time lapse since two sheets were necessary for making the measurements.

Scoring.—Each task was subdivided into work units so that rate scores were available for the predetermined intervals. The task of speed of writing digits (a) was subdivided into 4 work units of 48 digits per unit. Individual rate of writing in terms of digits per second was determined for each work unit. The task of speed of writing words (b) was subdivided into 2 work units and the unit of

measurement was letters written the first minute and letters written the second minute. The tasks involving speed of addition were scored as digits per second (rate of total addition) and digits added correctly per second (rate of correct addition). The task of 3 digit addition (c) was subdivided into 5 work units of 4 problems per unit. The task of 6 digit addition (d) was subdivided into 4 work units of 4 problems per unit. The task of 9 digit addition (e) was subdivided into 4 work units of 2 problems per unit. The substitution subtest of the Babcock-Levy Scale (f) consists of 5 lines of 10 substitutions per line. Individual performance on each of the 5 lines was timed and the performance rate was computed in terms of digits substituted per second.

Analysis.—Data were analyzed by determining the slope of the linear regression line of performance rate on the work unit number for each individual for each task. The slope was determined by a least squares solution. Linear regression was found to describe adequately all the data except the substitution subtest of the Babcock-Levy Scale for the younger population. The regression line of this task was also treated as a linear function since the difference between the coefficient of correlation (r) and the correlation ratio (η) was not significantly different for the older population and since all other functions were so described. For each task, mean slope differences were determined between the two populations.

Results

In all tasks except speed of writing digits, decrement in performance rate was found with continuous work. For the speed of writing digits task, a greater performance rate was found with successive work units, but the mean increment difference between the 2 populations was not significant. Significant age differences ($P < .01$) in the decrement relationship of speed of response to continuous repetition of the performed task were found in all the remaining tasks except writing words and 9 digit addition (table 1).

All slopes describing the relationship between performance and successive work units for the younger population were negative and differed statistically from zero ($P < .01$). These slopes, except correct 9 digit addition, were less negative in every case for the older population, but differed significantly from zero

Table 1. Comparison of Performance Rate as a Function of Work Units (Slope) of 2 Age Groups.

Work Decrement[1]	Age = 60–69 Years N = 50		Age = 20–29 Years N = 50				
	Mean	Mean	Mean	Mean	Mean diff.	t	P
Digits	+ .018	.005	+ .025	.006	.007	.90	—
Words	−1.760	1.353	−5.620	1.258	3.860	2.09	< .05
3 Digit Addition							
Total	− .030	.008	− .132	.018	.102	5.18	< .01
Correct	− .022	.009	− .135	.022	.113	4.75	< .01
6 Digit Addition							
Total	− .030	.008	− .083	.011	.053	3.90	< .01
Correct	− .013	.011	− .086	.015	.073	3.92	< .01
9 Digit Addition							
Total	− .036	.010	− .066	.011	.030	2.02	< .05
Correct	− .059	.013	− .054	.018	.005	0.22	—
Babcock Substitution	− .002	.003	− .035	.007	.033	4.33	< .01

[1] All work decrement measurements are in terms of digits/second/work unit, except the word task which is in terms of letters/minute/work unit.

in all but 4 tasks. The slope for correct 3 digit addition was significant at $P < .05$, but the slopes for writing words, the correct 6 digit addition, and the Babcock-Levy substitution subtest were not significant even at this confidence level.

In spite of the larger work decrements in the younger group, both the initial and final levels of performance in every task were greater in the younger group than in the older group (fig. 1). This was true for both total rate of response and correct rate of response.

As indicated earlier, the younger population was more highly educated than the older population. To evaluate the possibility that education rather than age was responsible for the larger decrements, both populations were divided into 2 groups for each of the 6 tasks. The first group was composed of 25 subjects with the most years of formal education and the second group was composed of 25 subjects with the least years. The lower half of the older group had 4 to 6 years of education and the higher half had 7 to 12 years. The younger group was divided into halves with 7 to 12 and 13 to 20 years of formal education. Tests of mean slope differences were made. These tests, as summarized in table 2, indicated that the higher education level of the younger population was not responsible for the larger performance decrements.

Mean slope differences between male and female subjects in the same age group were tested since more women comprised the younger group and more men the older group. Sex differences in slope were not found to be significant.

Discussion

The results of this study have shown that there are age differences in performance decrement with continuous work. The differences, although small, are statistically significant, and therefore merit consideration in precise lab-

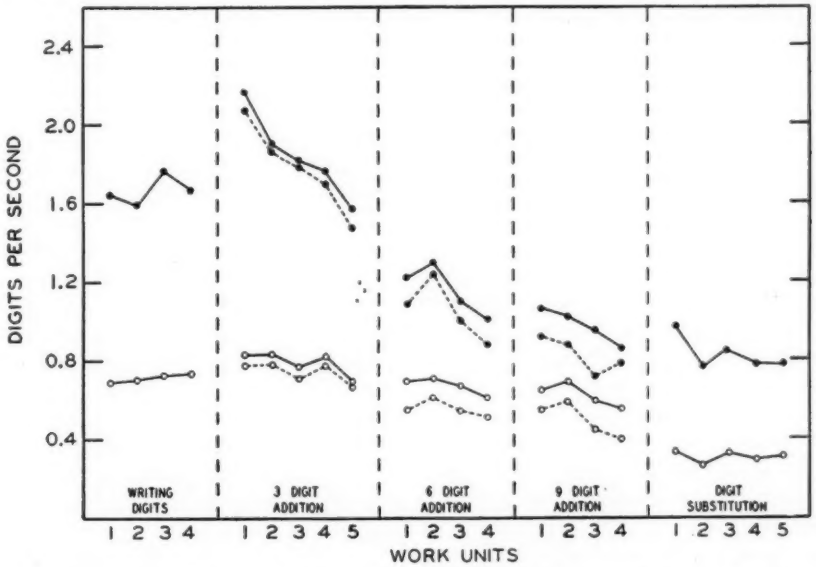

FIG. 1. Mean decrement curves for tasks of varying difficulty for 2 populations; 50 subjects aged 20 to 29 years (● — ●), and 50 subjects aged 60 to 69 years (O — O). Mean measurements computed as digits per second. Work units for individual tasks are as follows: writing 48 digits, 4 addition problems of 3 and 6 digits per problem, 2 addition problems of 9 digits per problem, and 10 digit substitutions. Tasks are shown in order of administration, except for a writing words task that was given after writing digits. For addition tasks, rates are computed as total addition (solid line) and correct addition (dashed line).

TABLE 2. COMPARISON OF MEAN SLOPES BETWEEN GROUPS WITH HIGHEST AND LOWEST YEARS OF EDUCATION IN 2 AGE SAMPLES.

Work Decrement[1]	Age = 60–69 Years			Age = 20–29 Years		
	Years of Education			Years of Education		
	Highest	Lowest		Highest	Lowest	
	Mean	Mean	t[2]	Mean	Mean	t[2]
Digits	+ .020	+ .017	.33	+ .024	+ .026	.15
Words	−2.920	−0.600	.86	−5.500	−5.73	—
3 Digit Addition						
Total	− .015	− .044	—	− .094	− .170	—
Correct	− .006	− .038	—	− .097	− .173	—
6 Digit Addition						
Total	− .045	− .014	1.94	− .082	− .083	—
Correct	− .005	− .021	—	− .091	− .082	.03
9 Digit Addition						
Total	− .060	− .014	2.30	− .072	− .059	.59
Correct	− .065	− .054	.41	− .049	− .058	—
BabcockSubstitution	− .005	+ .001	.10	− .031	− .038	—

[1] All work decrement measurements are in terms of digits/second/work unit, except the word task which is in terms of letters/minute/work unit.

[2] t ratios presented only for those tests where manifested work decrements were larger for the highest education groups. One t ratio was significant at $P = < .05$; other t ratios were not significant even at this confidence level. In tests where t ratios are not presented, the differences in decrement between the 2 age samples could not have been credited to the education level.

oratory investigations. Previous studies have indicated that the tasks used in this study can be valuable adjuncts in the psychologic examination of the elderly (6, 7). In such examination, these tasks may be given to both young and elderly subjects without reference to the decrement curve. The tasks as originally reported are two minute tasks and the manifested decrements for this period are not sufficiently large to affect clinical determinations. However, this does not preclude the possibility that functions, other than those considered in this study, may decline greatly with continuous work. If the rate of decline does vary greatly with age, clinical conclusions must consider the portion of the decrement curve where age comparisons are made. Differences can be large or small depending on the relative age slopes of performance decline. Similarly, personnel evaluations in industry might do well to consider age differences in decrement of performance.

The results of this study indicate that the elderly subjects can, in some instances, be penalized when observations are made only on the initial period of work. Dill (12) in reviewing work on muscular exercise, concludes that occupations emphasizing speed and strength are probably better suited to younger men, but older people may be better suited for work requiring endurance.

The small slopes found in this study are in accord with those found by previous investigators (3, 5, 22). Large individual differences were found in this study and this too has been seen previously (9, 13, 17, 23). Bills (3, 5) explained these findings by the phenomenon of blocking. Blocking affords the subjects pauses for rest and therefore limits the magnitude of decrement. On this basis, the

smaller slopes found in the older population in this study might be indicative of a greater frequency of blocking. Mallioux and Newburger (16) found that psychotic patients blocked more frequently than did Bills' normal subjects. In this connection, another investigation (8) indicated that the elderly individual may show a defect in thought arising from low rate of verbal association.

It is known that spaced practice is superior to massed practice. If rest provided by blocking is sufficient to decrease decrement, the two to ten seconds taken between tasks in this study should have had some effect on the slopes of the output curves. Rest might also explain the fact that an increment was found in writing digits since half the task was separated by the time necessary to change the sheets of paper used.

Factors other than rest may also be related to the size of the decrement slopes. In this study task materials were varied in difficulty and in work unit intervals, but order of task administration was kept constant. The influences of the work unit interval and of task difficulty have been expressed by several investigators (14, 18, 20, 25). In this study the work unit interval, in terms of time, was an individual phenomenon. Individual rates of output determined the time spent on a problem and therefore on a work unit interval. The older population, working at a slower rate, had in effect a longer time interval for work units. This could possibly have obscured decrements. The time interval for work units is also a function of task difficulty. It was shown that slopes, for the younger population, were smaller with the more difficult material (fig. 1). Since difficulty of task makes for slower output rates (7), decrements may thus have been obscured by increasing difficulty. The smaller slopes found with the more difficult tasks in the younger population might also be accounted for by the fact that they were presented to both populations towards the end of the individual test sessions. Transfer of fatigue or the effects of task order of administration have been shown to be factors (4, 5, 22).

Summary

1. The purpose of this study was to investigate age differences in the relationship of speed of response to continuous repetition of the performed task.

2. Six simple tasks involving rate of response were individually administered to 100 subjects. The subjects were divided into 2 groups; 50 subjects aged 20 to 29 years, and 50 subjects aged 60 to 69 years. Subjects were of both sexes, white, born in English-speaking countries, and had a minimum of four years formal schooling.

3. The task materials used were: speed of (a) writing digits and (b) writing words, addition of (c) 3 digit, (d) 6 digit, (e) 9 digit problems, and (f) digit substitution in the subtest of the Babcock-Levy Scale, the Revised Examination for the Measurement of Efficiency of Mental Functioning. Each task was subdivided into 2 to 5 work units and time scores computed as rates of response were determined for each work unit of each individual. For the addition tasks, rate of correct response was also determined. Data were analyzed by determining the slope of the linear regression line of performance measurements on the work unit number. For each task, mean slope differences were determined between the 2 populations.

4. In all tasks except writing digits, decrement was found in both groups. All mean decrement differences between the 2 age groups were statistically significant ($P < .01$) except the decrement differences in 9 digit addition and writing words.

5. It can be concluded that age differences in work decrement were found in this study. Performance decline with continuous work was greater in the younger population than in the older one, although initial and final levels of performance rate were higher in the younger population.

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Studies on Aging: Correlation of Skin Morphology with Age and Hormone Excretion

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In several previous studies (8, 9, 10) the effect of topical administration of steroid hormones on the histologic appearance of senile human skin has been investigated. To the knowledge of the authors no data are available in the literature concerning the correlation between morphologic age changes in the skin and the endocrine or metabolic status of human individuals. The present study was undertaken with the purpose of providing observations concerning this subject. The investigations included 26 patients aged 61 to 83 years. In these patients the histologic appearance of the skin as observed in biopsies was compared with quantitative determinations of urinary hormone excretion and with various blood analyses.

Materials and Methods

Eleven females and 15 males volunteered for this investigation. With the exception of one female who had stasis ulcers of both legs and one male who developed congestive heart failure during the period of study, all were considered to be in good health.

Routine urinalyses and blood counts, performed in all instances, were within normal limits. Blood chemical determinations were made in all patients and consisted of: true blood sugar [Somogyi filtrate (18) and Folin-Wu color development (7)], serum chloride (16), blood uric acid (15), blood urea nitrogen (13), serum cholesterol (2), serum calcium (4), serum inorganic phosphate (6), serum total protein (14), and serum sodium (11).

Hormone assays were carried out on forty-eight or seventy-two hour collections of pooled, refrigerated urine. Separate aliquots were used for the various assays.

For the determination of neutral 17-ketosteroids, the urine was hydrolyzed by boiling for seven minutes with 15 volumes per cent hydrochloric acid. The urine was cooled and extracted with ether. The ether extract was washed with sodium bicarbonate and sodium hydroxide to remove phenols and estrogens and finally was washed with water and evaporated to dryness. The ketonic steroids were isolated by the Girard reaction; separation into alpha and beta isomers by means of digitonin was not done. Color development was performed by the Callow and Callow (3) absolute alcohol method for the Zimmerman reaction. Duplicate determinations were made in all cases and recoveries were run frequently. Our normal values for healthy individuals between the ages of 17 and 35 were 10 to 20 mg. for males and 6 to 12 mg. for females per twenty-four hours.

Estrogen determinations were carried out by a fluorometric method (5). The urine was hydrolyzed with 15 volumes per cent hydrochloric acid for twenty minutes, cooled, and extracted with ether. The ether extract was washed with sodium bicarbonate and with water and evaporated to dryness. The residue was taken up in benzene and extracted 4 times with N potassium hydroxide. The potassium hydroxide solution containing the estrogens was brought to pH 9 $\pm$ 0.5 with 6N sulfuric acid and potassium carbonate-potassium bicarbonate buffer. This aqueous solution was extracted 4 times with ether. The ether extracts were combined, washed once with 40 per cent sulfuric acid, once with water, and evaporated to dry-

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ness. The residual material was taken up in 0.5 to 1.0 cc. of absolute ethanol-toluene (1:19). The fluorescence was developed and measured according to the method of Bates and Cohen (1). The measurements, using estrone as a standard, were performed with the Farrand fluorometer (5).

It should be mentioned at this point that evaluation of data obtained by the fluorescence method for the estimation of estrogens requires considerable caution. Engel and his associates (5) have analyzed the fluorescent material in urine by countercurrent distribution, which partitions the urinary estrogens into separately measurable fractions of estrone, estradiol, and estriol. The material thus obtained is measured by fluorometry.

The lowest levels of estrogen detectable by this technique in human urine with sufficient accuracy were those found in normally menstruating women; the fluorescent material obtained from male urine did not show the same countercurrent distribution pattern as the 3 estrogen fractions. Hence, Engel concluded that it was largely nonspecific fluorescent material. Interestingly enough, Humm, Munson, and Salter (12) have made comparable observations with a colorimetric method for estrogen determination. As the fluorescent material in all the old individuals studied by us is present at the same or even lower levels than in young adult males, we must present the results of our fluorometric determinations with the reservation that their significance in terms of estrogenic material is not entirely clear.

Gonadotropins were isolated from the urine by the ultrafilter technique of Gorbman (11). Aliquots of the dry powder so obtained were eluted with water, serial dilutions made, and injected into 21 to 24 day old CFW female mice in the usual manner. Two mice were used at each level of dilution; from 4 to 6 levels were usually run. A reaction was considered positive if the treatment increased the mouse uterine weight 100 per cent. The strain of mice used was also standardized in a similar manner against pregnant mare's serum (International Standard); hence, the results of our assay could be expressed in terms of I.U. of FSH. Normal values for healthy young adults range from 4 to 10 I.U. per day. We believe that this procedure has a distinct advantage over other commonly used methods because the data, expressed in terms of a fixed standard, lend themselves far better to accurate comparisons with the data of others.

Skin biopsies were taken from the anterior or anteromedial surface of the middle third of the thigh after local anesthesia of the surrounding area with 1 per cent procaine. Punch biopsies 4 to 6 mm. in diameter were obtained with a Keyes punch, fixed immediately in a 1:4 dilution of Bouin's fluid, embedded in paraffin, and stained with hematoxylin-eosin in the usual manner. Weigert-van Gieson stains were used to study the connective tissue elements and elastic fibers.

In the evaluation of the changes of the senile skin, the following morphologic criteria were used:

1. Width of the epidermis as expressed by the number of cell layers.

   Grade 1 — 3 to 4 cell layers;
   Grade 2 — 3 to 7 cell layers, averaging 4;
   Grade 3 — 4 to 6 cell layers.

2. Presence and size of epithelial pegs projecting into the cutis and the corresponding presence or absence of papillae. This was graded as follows:

   Grade 1—straight baseline of the epidermis without any projecting pegs;
   Grade 2—wavy baseline without distinct peg formation;
   Grade 3—presence of occasional, small pegs;
   Grade 4—presence of more numerous and larger pegs.

3. Size and differentiation of epidermal cells.

   Grade 1—small in size with densely-stained cytoplasm and hyperchromatic nuclei; transition between basal and prickle cells indistinct;
   Grade 2—differentiation of basal cells distinct with cells somewhat larger;
   Grade 3—basal cells columnar, all cells larger with lighter-staining cytoplasm, nuclei increased in size.

4. Amount of keratohyalin.
   - Grade 1—interrupted, single, granule-bearing layer of cells;
   - Grade 2—uninterrupted single layer of granule-bearing cells;
   - Grade 3—more than 1 layer of granule-bearing cells, with heavier granules;
   - Grade 4—3 or more layers of heavily granulated cells.

5. Degree of hyalinization of the collagenous fibrils.
   - Grade 1—coarse, homogeneous fibrils, closely packed with very few fibroblastic nuclei;
   - Grade 2—less coarse, less densely packed fibrils, increased number of nuclei;
   - Grade 3—finer fibrils with numerous nuclei, architecture approaching that of normal skin.

6. Elastic fibrils.
   - Grade 1—decreased number of fibrils, almost complete absence in subepithelial stratum, advanced fragmentation and clumping;
   - Grade 2—fibrils more numerous, some finer fibrils present subepithelially, less fragmentation and clumping, occasional longer fibrils;
   - Grade 3—ample network of fibrils both subepithelially and in the cutis; longer fibrils, much reduced fragmentation, no clumping.

7. Vascularity and cellularity of the cutis.
   - Grade 1—absence of capillaries, small number of fibroblasts;
   - Grade 2—occasional capillaries, more numerous fibroblasts;
   - Grade 3—more numerous patent capillaries.

Results

The biochemical results are presented in tables 1 and 2. As mentioned previously, routine urinalyses and blood morphology were within normal limits in all cases.

1. *Biochemical and Hematologic Data.*—The patients studied showed no significant hematologic changes and no deviations in respect to blood chemistry except for 4 instances of hypercholesterolemia, 1 instance of hypoglycemia, and 1 of elevated urea nitrogen (tables 1 and 2).

2. *Neutral 17-Ketosteroids.*—The 17-ketosteroid levels were generally low with an apparent but statistically not significant tendency to decrease with advancing age (table 3). This tendency is in keeping with statistically satisfactory observations made by others. There is

Table 1. Biochemical Data, Males.

Code	Age	Blood Glucose Mg. %	Blood Uric Acid Mg. %	Blood Urea Nitrogen Mg. %	Serum Cholesterol Mg. %	Serum Calcium Mg. %	Serum Inorganic Phosphate Mg. %	Serum Chloride (NaCl) Mg. %	Serum Sodium Mg. %	Serum Total Protein Gm. %	Urinary Hormone Excretion		
											Neutral 17-Ketosteroids Mg. per 24 Hours	Estrogens µg. per 24 Hours	Gonadotropins I. U. per 24 Hours
HOR	62	96	2.95	15.2	294	10.0	3.0	585	325	6.4	8.0	3.0	>1.3, <2
BER	64	83	3.5	16.0	290	10.6	2.4	622	320	6.1	10.5	5.0	> 7, <16
MCF	65	88	4.0	15.1	248	9.8	2.4	614	323	6.6	3.5	....	< 2
COH	65	77	3.55	14.2	250	8.8	2.2	575	312	6.15	7.2	4.0	....
LYN	67	80	4.0	14.3	215	10.0	2.6	584	315	7.6	4.9	3.7	> 4, <10
HES	67	83	2.20	13.0	160	10.0	3.6	580	317	6.6	3.3	6.3	>10
MOO	70	93	3.25	14.6	240	9.5	3.7	583	315	6.6	8.0	24.4	>10
MCC	70	91	3.3	13.6	209	9.8	2.6	596	315	7.1	4.3	7.3	>10
BIE	71	86	3.1	12.5	185	10.2	3.0	588	317	6.6	4.0	6.5	< 4
MUR	72	77	4.3	12.2	270	11.0	3.8	578	313	6.6	4.4	5.0	> 6, <16
FLA	72	75	2.4	21.7	210	10.8	3.7	624	324	7.1	3.6	11.9	>10
ODO	74	94	3.15	14.7	204	10.3	3.0	588	320	6.9	7.4	5.2	>10
FUL	74	100	3.25	14.6	210	9.8	2.6	578	305	6.6	6.6	5.2	>10
NOR	81	85	3.3	16.4	166	9.0	2.2	620	323	6.9	7.0	6.0	> 4, < 8
HER	84	70	2.25	14.0	200	8.3	3.0	602	312	5.8	1.0	3.7	>20

TABLE 2. BIOCHEMICAL DATA, FEMALES.

Code	Age	Blood Glucose Mg. %	Blood Uric Acid Mg. %	Blood Urea Nitrogen Mg. %	Serum Cholesterol Mg. %	Serum Calcium Mg. %	Serum Inorganic Phosphate Mg. %	Serum Chloride (NaCl) Mg. %	Serum Sodium Mg. %	Serum Total Protein Gm. %	Urinary Hormone Excretion		
											Neutral 17-Ketosteroids Mg. per 24 Hours	Estrogens µg. per 24 Hours	Gonadotropins I. U. per 24 Hours
DEL	61	90	2.7	14.0	224	10.3	2.4	590	310	6.6	3.6	4.3	>10
MAU	62	96	3.0	11.9	200	9.6	3.0	573	312	6.35	9.0	5.4	< 4
DAN	63	75	2.4	14.6	232	9.4	3.6	621	313	6.6	4.0	6.0	>32
GOL	63	78	3.6	9.9	340	10.8	4.0	581	335	6.5	7.9	8.0	>16, <32
DRI	64	84	2.8	12.4	195	11.1	3.3	600	316	6.9	6.0	11.2	>10
MUL	65	79	3.1	14.1	216	10.6	2.7	595	312	6.35	4.5	4.9	>10
MCF	65	91	3.0	13.2	200	9.9	2.5	604	325	6.1	3.6	2.6	> 4
DON	70	63	2.2	18.0	277	11.2	3.7	620	335	6.15	7.0	1.0	>16, <32
PLA	74	90	3.2	13.5	210	10.2	3.1	614	307	6.8	2.6	3.2	>10
HAM	74	75	2.7	13.5	299	11.0	3.4	608	325	6.6	4.3	2.0	> 7, <16
MIT	83	100	2.25	12.5	160	10.2	2.4	582	305	6.1	2.4	11.5	>10

no significant difference between males and females in this age group.

3. *Gonadotropins.*—The excretion of gonadotropins was elevated, as expected, in most patients. The excretion of gonadotropins in normal adults ranges according to our method between 4 and 10 I. U. per day; consequently all values above 10 I. U. must be considered elevated, whereas those below 4 are considered to be low. We prefer not to place too much importance on the numerical value of the gonadotropin assay; for purposes of interpretation, we consider only whether the excretion is low, normal, or high. It is our belief that a bioassay in which organ weights are reported numerically, such as is occasionally current practice, lends an entirely false sense of quantitative precision to a bioassay method which is not at all precise. The lack of precision of such methods is forcefully emphasized when one recalls that perhaps only 1 or 2 mice may be used in some instances. Even with our technique, where 2 mice are used at each level of dilution and a total of 6 to 8 mice may be used, we prefer to avoid the impression of excessive numerical precision.

Two assays in females and 1 in a male yielded insufficient data for distinct classification as normal, low, or elevated. Of 10 satisfactory determinations in women, however, 9 were elevated and 1 was low. In 14 determinations in men, 9 were elevated, 3 were low, and 2 were at normal levels. These figures seem to indicate that elevation of gonadotropins, though present in most cases, is less consistent in the male than in the female.

No correlation could be found between the excretion of gonadotropins and estrogen nor between that of gonadotropins and 17-ketosteroids. Elevated gonadotropin excretion occurred with both the lowest and highest ketosteroid values, both in males and females.

4. *Estrogens.* — No correlation could be found between the level of estrogen excretion and age (for the age-group considered in this investigation), nor was there any significant difference between the values found in males vs. females.

5. *Histologic Changes.*—Evaluation of the biopsy material according to the criteria mentioned above showed that atrophy of the skin in the aged is noticeable even in the younger members of the group studied and becomes especially pronounced after the age of 70.

TABLE 3. CORRELAITON OF KETOSTEROID EXCRETION WITH AGE.

Group	Number in Group	Ketosteroids, Mg./24 Hours	t-Ratio **	Significance
Males, 60-69	5	6.0±3.1*	.53	n. s.
Males, 70 or over	8	5.3±2.4		
Females, 60-69	7	5.5±2.2	1.09	n. s.
Females, 70 or over	4	4.1±2.1		
Entire Group, 60-69	12	5.7±2.3	.85	n. s.
Entire Group, 70 or over	12	4.9±2.3		

* Standard deviation for small groups, calculated as:

$$\sigma = \left(\frac{\Sigma (x - M)^2}{n - 1} \right)^{1/2}$$

** Computed according to the formula

$$t = \frac{M_1 - M_2}{s \left(\frac{1}{n_1} + \frac{1}{n_2} \right)^{1/2}}$$

where $$s = \left[\frac{\Sigma (x - M_1)^2 + \Sigma (x - M_2)^2}{n_1 + n_2 - 2} \right]^{1/2}$$

In the course of senile atrophy, the width of the epidermis decreases from a normal average of 6 to 7 cell layers progressively to a minimum of 3 to 4 layers. The epithelial pegs diminish in number and decrease in size until they disappear completely; simultaneously, the demarcation between epidermis and cutis loses its character of a wavy line and changes to an almost straight line. More or less complete disappearance of the papillae is concomitant. The size of the epidermal cells decreases considerably both in respect to cytoplasm and nucleus; both appear to be denser, with greater affinity to alkaline dyes. Morphologic differences between basal and prickle cells tend to disappear. Keratohyalin granules are scarce or absent.

The number and caliber of the capillaries is decreased generally throughout the cutis, not only in the subepidermal region. The tissue of the cutis is conspicuous for its lack of cellularity and for the thickness and coarseness of the collagenous fibrils.

The distribution of the elastic apparatus is uneven; the number of well-maintained, longer fibrils is decreased. They are replaced by numerous short fragments which are often swollen and tinctorially abnormal. Adjacent collagen fibers show the so-called basophilic

TABLE 4. CORRELATION OF 17-KETOSTEROID VALUES AND HISTOLOGIC SKIN OBSERVATIONS, MALES.

Code	Age	17-Ketosteroids	Epidermal Width	Epidermal Pegs	Epidermal Cells	Keratohyalin	Collagenous Fibers	Elastic Network	Vascularity	Score
HOR	62	8.0	3	3	1	1	2	2	2	14
BER	64	10.5	1	3	1	2	2	2	2	13
MCF	65	3.5	3	2	1	1	2	1	2	12
LYN	67	4.9	2	3	2	2	1	3	2	15
HES	67	3.3	3	3	3	1	2	2	2	16
MOO	70	8.0	3	1	2	2	2	2	2	14
BIE	71	4.0	1	1	2	1	1	1	1	8
MUR	72	4.4	1	1	1	2	1	1	2	9
FLA	72	3.6	1	2	2	2	1	1	2	11
ODO	74	7.4	1	3	2	2	2	1	2	13
FUL	74	6.6	2	3	1	2	2	2	1	13
NOR	81	7.0	1	2	1	1	1	1	1	8
HER	84	1.0	2	3	1	1	2	3	2	14

TABLE 5. CORRELATION OF 17-KETOSTEROID VALUES AND HISTOLOGIC SKIN OBSERVATIONS, FEMALES.

Code	Age	17-Ketosteroids	Epidermal Width	Epidermal Pegs	Epidermal Cells	Keratohyalin	Collagenous Fibers	Elastic Network	Vascularity	Score
DEL	61	3.6	1	2	2	3	2	3	2	15
MAU	62	9.0	3	3	3	2	2	2	2	17
DAN	63	4.0	1	2	1	2	2	2	2	12
GOL	63	7.9	3	1	3	2	2	2	3	16
DRI	64	6.0	1	2	1	3	1	1	2	11
MUL	65	4.5	1	2	1	2	1	1	1	9
MCF	65	3.6	2	3	2	3	2	2	2	16
DON	70	7.0	1	1	1	2	2	1	1	9
PLA	74	2.6	1	2	1	2	2	1	2	11
HAM	74	4.3	1	2	2	1	2	2	2	12
MIT	83	2.4	1	2	2	2	2	2	2	13
								Over-all Average, tables 4 and 5		12.5

degeneration. Disappearance of the finer arcuate elastic fibrils in the atrophic papillary body is almost complete.

An attempt was made, according to the morphologic gradings mentioned previously, to establish some statistical relationship between the changes noted in the skin and the urinary hormone excretion. The skin biopsies were evaluated as shown in tables 4 and 5.

6, *Correlation of Skin Atrophy with Age.*— The individuals studied were divided according to sex and according to age. Those under 70 years were placed in one group and those 70 years or over formed a second group. The mean and standard deviation of the mean was calculated for each group and the t-ratio computed as described previously. Table 6 shows the data obtained in this manner. It is seen that a significant correlation ($p = .05$) exists between the degree of skin atrophy and age in males; in females the data fall short of significance. However, when the entire groups (male plus female) above and below the age of 70 are compared, the difference in skin atrophy is significant ($p = .02$).

By a similar technique, correlations were sought between the degree of skin atrophy and the urinary excretion of various hormonal

TABLE 6. CORRELATION OF SKIN ATROPHY WITH AGE.

Group	Number in Group	Skin Atrophy Score	t-Ratio	Significance
Males, 60-69	5	14.0±1.2	2.3	p=.05
Males, 70 or over	8	11.3±2.5		
Females, 60-69	7	13.7±3.1	1.4	n. s.
Females, 70 or over	4	11.3±1.7		
Entire Group, 60-69	12	13.8±2.4	2.7	p=.02
Entire Group, 70 or over	12	11.2±2.3		

metabolites. There was obviously no correlation between skin atrophy and estrogen excretion or between skin atrophy and gonadotropin excretion. No significant correlation could be demonstrated statistically between the ketosteroid excretion and the condition of the skin. Whatever correlation between skin atrophy and ketosteroid excretion might be demonstrable in a larger series could well be an indirect one, resulting from the fact that both skin atrophy

and ketosteroid excretion do correlate with a common factor, namely age.

Summary

1. The morphology of the skin in 26 aged individuals (11 females and 15 males) was studied in biopsy specimens and the observations correlated with data obtained by biochemical investigation and hormone assays.

2. No correlation was found between the degree of skin atrophy and the data obtained by chemical study of the blood.

3. Ketosteroid excretion was found to be low; the known decrease with advancing age could not be proved statistically within the age group included in this study.

4. Excretion of gonadotropins was elevated in most cases, more consistently in females than in males.

5. Estrogenic material, determined by fluorometry, was generally low in both sexes.

6. The degree of skin atrophy correlates well with the individual's age.

7. A correlation between skin changes and ketosteroid excretion could not be demonstrated.

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The Effect of Age on the Intravenous Glucose Tolerance Test

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THE administration of glucose intravenously rather than orally in the performance of the glucose tolerance test eliminates the variable factors of gastric emptying time and intestinal absorption and permits a more accurate appraisal of the organism's ability to dispose of glucose. The test is particularly useful in the investigation of carbohydrate metabolism in patients without diabetes and has been widely applied in the study of endocrine disease.

During the course of studies of carbohydrate metabolism in osteitis deformans (Paget's disease of bone) (14) it was found that a control series of normal aged patients exhibited a depression in tolerance to intravenously administered glucose when compared to normal standards described by Soskin (17). This did not conform with the results of Lozner and his associates (10), who failed to note any influence of age on the test. Tunbridge and Allibone (18), however, found that 4 of 8 aged subjects showed abnormal curves and Smith and Shock (16), in a carefully conducted study, described decreased tolerance in aged males.

We decided to augment our original series of older subjects in order to investigate more thoroughly the effect of age on the intravenous glucose tolerance test.

METHODS

The Intravenous Glucose Tolerance Test

Ninety-seven subjects were studied in two groups. Group I consisted of 48 healthy volunteers, 18 men and 30 women, most of whom were internes, residents, medical students, and nurses. Their ages ranged from 16 to 39 years; 25 were Jewish and 23 Gentile.

Group II comprised 49 subjects, 30 men and 19 women, ranging in age from 40 to 90 years; 39 were over 60 years of age. All but one were Jewish. Most of these subjects were volunteers from a home for the aged. They were, as far as could be determined by history and physical examination, free of pathologic conditions that might adversely affect carbohydrate metabolism. Subjects with diabetes mellitus, hepatomegaly, or known liver disease, diastolic hypertension, rheumatoid arthritis, heart failure, or significant obesity were eliminated. All were ambulatory and none were more confined than any comparable group of persons of a similar age. Morning urine specimens were obtained from each subject of Group II so that individuals with glycosuria could be eliminated.

It was not possible to place the 97 subjects in Groups I and II on a high carbohydrate diet prior to the test but it was ascertained by history that the previous diet was adequate. Tests were performed in the morning after an overnight fast. The technique of Soskin (17) was found most suitable. One-third gm. of dextrose per kilogram of body weight in a 50 per cent solution was injected intravenously within 3 to 5 minutes and 0.1 cc. capillary blood specimens were obtained 15, 30, 60, 75, 90, and 120 minutes thereafter. Blood sugar values were determined by the Lauber-Mattice method (9), which removes non-glucose reducing substances, and thus measures "true" blood sugar. They were read on a Klett-Summerson photoelectric colorimeter. Duplicate blood sugar values showed an average error of 1.4 mg. per cent and a range of 0-6 mg. per cent.

The Mechanism of the Impaired Glucose Tolerance in Old Age

Thymol turbidity (3), thymol flocculation (13) and cephalin-cholesterol (6) liver function tests were performed in 6 young and 26 old subjects. The adrenalin test to gauge available liver glycogen stores was performed

in 9 young and 6 old subjects as described by Kinsell and his associates (8) but without preliminary diet preparation.

Results

The Intravenous Glucose Tolerance Test

Table 1 shows the mean blood sugar values, standard deviations, and values of "t" (5).

Figure 1 illustrates the mean blood sugar curves. The older subjects exhibited higher blood sugar levels at every point on the curve except at two hours, and the differences between the age groups are statistically significant at all points except at two hours. Blood sugar readings showed wider variations as illustrated by the larger standard deviations in the older

Table 1. Mean Blood Sugar Values, Standard Deviations and "t" Values.

Time Intervals (Minutes)	Number of Subjects	Age 16-39	S. D.	Number of Subjects	Age 40 and Over	S. D.	Difference	"t" Values
Fasting	48	(60.1)	12.6	49	(72.4)	17.7	+12.3	3.97[2]
15	48	95.7	20.3	48	109.7	25.4	+14.0	2.98[2]
30	48	52.8	19.1	48	72.6	27.5	+19.8	4.13[2]
60	48	4.5	14.4	49	30.9	23.2	+26.4	6.77[2]
75	48	−5.8	9.7	48	11.1	19.1	+16.9	5.45[2]
90	48	−7.3	10.1	48	−0.5	15.6	+2.3	2.52[1]
120	40	−6.7	9.5	16	−10.3	13.6	−3.6	1.13

[1]Significant difference between means ($p = <0.05$).
[2]Highly significant difference between means ($p = <0.01$).
Fasting blood sugars are absolute values; all others are the difference from the fasting value.

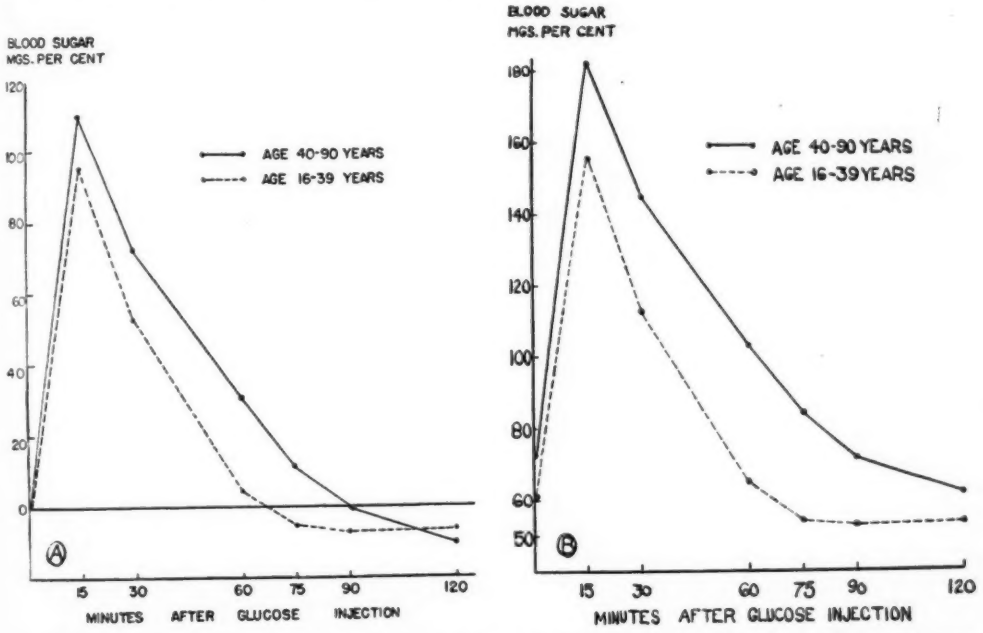

Fig. 1. Mean intravenous glucose tolerance curves for young and old subjects. In "A" blood sugars represent the milligrams difference from the initial fasting value expressed as zero. In "B" absolute blood sugar values are charted.

patients. The groups were further subdivided into five 20-year categories and the means for the one hour blood sugar compared.

Table 2, part A, shows the mean blood sugar values of these smaller age divisions and illustrates the higher blood sugar values in each of the three subdivisions over age 40 years when compared to the two groups under 40 years. The fasting blood sugars became significantly higher above age 60 years.

Table 2, part B, shows a statistical comparison of the one hour blood sugar values of the five 20-year groups. The subjects of Groups 16 to 19 years and 20 to 39 years do not differ significantly from each other, but do differ significantly from each of the three groups over 40 years of age. Conversely each of the older groups differs significantly from the two younger groups but not from each other. There was, however, no orderly progression noted in depression of glucose tolerance as one ascends through the 20-year groups from the youngest to the oldest.

The time required for the blood sugar to return to the fasting level is generally accepted as a good index of the rate of disposal of intravenously administered dextrose. Only 2 subjects (4 per cent) of the young group but 19 (39 per cent) of the older group failed to reach their fasting blood sugar level during the two-hour test period. This in itself is statistically significant ($t = 5.83$). If we calculate the means using only those patients whose blood sugar did return to the fasting level, for the young subjects the average return was accomplished in sixty-six minutes and for the older subjects in ninety-one minutes.

TABLE 3. MEAN BLOOD SUGAR VALUES AT 60 MINUTES.

Age Group	Male	Female	Difference	Value of "t"
0-39	1.1	6.6	5.5	1.28
40 and Over	29.6	33.1	3.5	0.51

TABLE 2. A. MEAN BLOOD SUGAR VALUES OF 5 AGE GROUPS.

Age Group	Fasting	15 Minute	30 Minute	60 Minute	75 Minute	90 Minute	120 Minute
16-19	(60)	98	58	9	−3	−5	−6
20-39	(60)	94	50	2	−8	−9	−7
40-59	(62)	112	76	27	9	−1	−12
60-79	(74)	106	71	31	8	−2	−10
80 and Over	(77)	116	74	35	20	2	−9

Fasting blood sugars are absolute values; all others are milligrams per cent difference from the fasting.

B. VALUES OF "T" SHOWING SIGNIFICANCE OF THE DIFFERENCES BETWEEN MEANS OF 5 AGE GROUPS AT 60 MINUTES.

Age Group	Number of Subjects	16-19	20-39	40-59	60-79
16-19	19	.....	.....	....	....
20-39	29	1.64	.....	....	....
40-59	10	2.25[1]	3.86[2]	....	....
60-79	28	3.62[2]	5.92[2]	0.43	....
80 and Over	11	3.98[2]	6.15[2]	0.76	0.53

[1]Significant difference between means ($p = <0.05$).
[2]Highly significant difference between means ($p = <0.01$).

No significant difference was found in the mean blood sugar values at sixty minutes in the young and old groups between males and females. The results are shown in table 3.

The Mechanism of the Impaired Intravenous Glucose Tolerance in Old Age

Liver Function.—The thymol turbidity test was above the upper limits of normal, i. e., 4 units, in none of the 6 young subjects and in 11 of the 26 older patients. Thymol flocculation occurred in only 1 subject. The cephalin-cholesterol was positive (i. e., 2 plus or above) in 4 of the older patients.

The glucose tolerance tests in those subjects of the older age group with impaired liver function showed no significant difference when compared to subjects from the same group with normal liver function. When the test was carried out in a 59 year old male with acute hepatitis, a thymol turbidity of 20 units, 4 plus thymol flocculation and cephalin-cholesterol, the blood sugar curve was normal for his age group. The glucose tolerance test was carried out in 4 subjects with a history of hepatitis in the past three years and with recurrent mild episodes of either jaundice or right upper quadrant pain that had been diagnosed chronic or recurrent hepatitis. Their glucose tolerance curves were normal.

The fact that liver dysfunction was noted only in the older subjects might appear to indict the liver as an important contributing factor to the impaired glucose tolerance of this group. Comparisons of glucose tolerance curves within the older age group itself, however, showed no difference between the curves of those subjects with abnormal liver function tests and those with normal liver function tests. This finding would tend to eliminate the importance of liver dysfunction in producing the impaired glucose tolerance of the older patients.

Available Stores of Liver Glycogen.—An attempt to insure adequate stores of liver glycogen by a preliminary high carbohydrate diet has been considered an essential preparation in the performance of glucose tolerance tests (7). Because we were unable to supervise the preliminary diet satisfactorily in all of our subjects, an attempt was made to gauge the available stores of liver glycogen by noting the blood sugar rise after the intramuscular injection of 0.01 cc. of 1:1000 epinephrine hydrochloride per kilogram of body weight. Although there is no completely reliable method of evaluating hepatic glycogen stores, the hyperglycemic response to epinephrine has been carefully evaluated recently by Kinsell and his associates (8) and promises to become an accepted clinical test. The maximum blood sugar rise was considered to be an index of the usual glycogen stores in our subjects without previous dietary preparation.

The results in 9 young and 6 older subjects are shown in fig. 2. It is evident that the response of the two groups is similar, although the range of response was greater in the young subjects, and suggests that differences in available stores of liver glycogen do not explain the depression of glucose tolerance in our patients over 40 years of age.

In order to investigate further the effect of preliminary diet, 3 of our old subjects were admitted to the hospital, and intravenous glucose tolerance tests were performed before and three days after the daily consumption of a diet containing 350 gm. of carbohydrate. This period of high carbohydrate intake is generally accepted as adequate dietary preparation preliminary to the performance of glucose tolerance tests (2, 4). No significant difference in blood sugar curves before and after the high carbohydrate diet occured in any of the 3 subjects. On the basis of the investigation of liver glycogen stores and of the effect of a high carbohydrate diet we do not believe that the difference in habitual dietary intake of old persons as compared to young explains the depression of glucose tolerance observed in the aged subjects.

Discussion

The data presented demonstrate that the subjects in this series over 40 years of age ex-

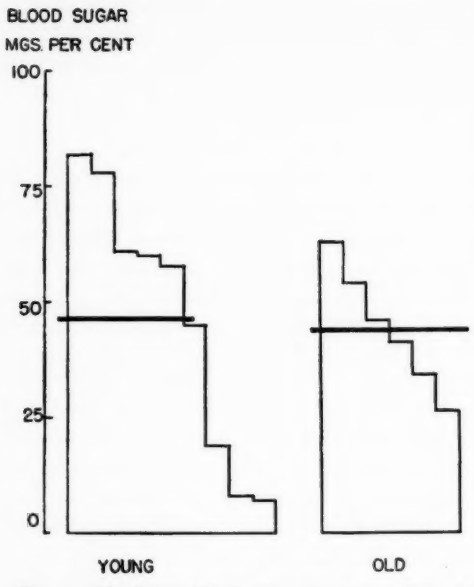

FIG. 2. Maximum blood sugar rise in 9 young and 6 old subjects after the intramuscular injection of 0.01 cc. of 1:1000 epinephrine hydrochloride per kilogram of body weight. Horizontal lines through the two groups represent the means.

hibited a significant depression in tolerance to intravenously administered glucose. These studies also suggest that the demonstration by others of impaired tolerance of the aged to orally administered glucose cannot be entirely explained on the basis of differences in the rate or efficiency of intestinal absorption.

Lozner, Winkler, Taylor, and Peters (10), in a very detailed analysis of the intravenous glucose tolerance test, stated that no correlation was noted between the results of the tests and the age of their subjects. Their published data included tests performed on 13 subjects over 50 years of age and 17 subjects under 30 years of age. We calculated the time to return to the fasting level in these two groups and found that for the younger group the mean return was accomplished in sixty-five minutes and for the older subjects in ninety-six minutes. This may be contrasted to our figures of sixty-six minutes for young subjects and ninety-one minutes for older subjects and suggests that there may be no actual discrepancy between our results and theirs.

Attempts to elucidate the mechanism of this "diabetic tendency" in the subjects over 40 years of age tended to eliminate the possibility that liver dysfunction, deficient stores of liver glycogen, or a preliminary low carbohydrate diet were responsible. Smith (15) studied arterial blood pyruvate levels after intravenous glucose administration in elderly subjects with prolonged glucose tolerance curves, in elderly subjects with normal intravenous glucose tolerance curves, and in diabetic patients. He concluded that insulin deficiency was not the primary factor responsible for the prolonged glucose tolerance curves observed in his group of aged subjects.

In such a study the selection of patients represents an important variable. It may be questioned as to whether there is such an individual as a "normal" aged subject. Degenerative disease factors such as undetected arteriosclerosis had an effect on our results in addition to the possibility of the influence of aging tissues. Examining individual blood sugar curves one finds several instances of patients in Group II exhibiting glucose tolerance curves characteristic of the youngest of our subjects. The larger standard deviation in the older age group demonstrates the greater variation of individual tests in old age and suggests that the truly normal old subject may dispose of glucose as rapidly as the young, whereas the mean figures may be heavily weighted with potential mild diabetics.

Mosenthal and Barry (12) have recently discussed the possible role of bed rest and inactivity in producing the reported alterations of oral glucose tolerance in the aged. Our older subjects, although inmates of a home for the aged, were ambulatory and as active as any group of comparable age outside their institution. Lowered sugar tolerance has been reported (1) in bedfast patients but the influence of various gradations of inactivity on the glucose tolerance test has not been studied to our knowledge. However, since older people

are generally less active than vigorous young adults this factor must receive consideration.

Few reports concerning the influence of racial factors on the glucose tolerance test have appeared in the literature. Morrison and Ohler (11) found no difference in the blood sugar curves of 24 Jewish compared to 25 non-Jewish patients. An analysis of the glucose tolerance curves of our Jewish and Gentile subjects in Group I revealed no significant differences. Racial influences on carbohydrate metabolism, if they exist, may become evident only with advanced age and may have had some influence on our results.

The hereditary background of the subjects of this study could not be accurately ascertained. Aged individuals usually have little or no knowledge of a family history of diabetes whereas young subjects can more frequently offer a more accurate family history. There were 2 subjects in each group with a known family history of diabetes mellitus. In 1 of these 4 subjects, a male aged 49 years, the glucose tolerance test was depressed significantly from the mean and in the other 3 the blood sugar curves were perfectly normal. Because our old age group was predominantly Jewish and Jews appear to have a greater tendency to develop diabetes mellitus, the observed impaired glucose tolerance of these subjects may have been influenced by racial factors.

It is evident that certain variable factors such as race, degree of physical activity, and a necessarily inaccurate family history of diabetes mellitus may have influenced carbohydrate metabolism in our older subjects. We are at present continuing these studies in an attempt to investigate the racial factor. At present we feel justified in concluding only that in this series of individuals advancing age was associated with a significant depression in tolerance to intravenously administered glucose.

Summary

1. Normal subjects over 40 years of age exhibited a significant depression of tolerance to intravenously administered glucose when compared to normal subjects 16 to 39 years of age.

2. This depression of glucose tolerance of the older subjects could not be attributed to liver dysfunction, deficient stores of available liver glycogen, or a previous low carbohydrate diet.

3. Certain factors that could not be controlled in this study such as race, family history of diabetes, and the degree of physical activity of our subjects were discussed.

4. The conclusion is tentatively offered that advancing age is associated with a depression of tolerance to intravenously administered glucose.

From the Research Department, Mount Sinai Hospital, Philadelphia, Pennsylvania. This paper was presented in part before the Endocrine Society of Philadelphia, January 18, 1950.

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Stability of Body Function in the Aged.
II. Effect of Exposure of the Body to Heat

CLETUS L. KRAG AND WILLIAM B. KOUNTZ

AGED individuals are usually considered to respond differently than the young to exercise, drugs, trauma, infections, heat, and cold. Few reports, however, are actually available concerning the response of the aged. In this study are presented the results of exposure of a group of aged human subjects to heat. A similar study of the response to cold has already been published (6).

Numerous investigations have been reported concerning the effect of heat exposure upon young subjects. The results of these studies are well known and show that the responses to heat exposure consist of such changes as peripheral vasodilation, perspiration, an increase in cardiac output, pulse rate, respiratory rate, and metabolic rate, a rise in body temperature and, if prolonged, of mental abberations, electrolyte and fluid disturbances, loss of control of body temperature, and death.

The extent to which the aged are able to withstand heat exposure has not been established. Selection of patients for fever therapy usually excludes the aged and middle-aged individuals and also younger patients with heart disease, anemia, malnutrition, and debilitation. It is also a well known fact that heat prostration is more frequent among the aged (5); however, whether this is due to the aging process itself or to diseases existing among this age group cannot be stated.

METHOD

Observations were made upon 14 subjects between the ages of 57 and 95 years, and on 12 young subjects 21 to 32 years of age (tables 1 and 2). The selection, evaluation, and classification of the subjects studied in this report were carried out in the same manner as in our previous publication on the effect of cold (6).

The subjects were exposed to heat by means of a standard type Burdick Fever Therapy Cabinet which was controlled to produce an ambient temperature of 100 to 115 F. (38 to 45 C.) the air of which was of approximately 100 per cent relative humidity. All subjects were observed under strictly controlled basal fasting conditions. Following a minimum of one hour bed rest after awakening in the morning, the oxygen consumption was determined by standard closed circuit methods and expressed in terms of cc. oxygen per square meter of surface area as well as percentage of normal by means of the Du Bois standard as modified by Boothby and Sandiford. In addition, the pulse rate, blood pressure, and oral temperature were recorded and an electrocardiogram taken. Following this the patient was weighed and moved into the pre-heated cabinet.

While in the cabinet and for a variable cooling period after opening the cabinet, serial observations were made of the oxygen consumption, electrocardiographic changes, pulse rate, oral temperature, rectal temperature,

TABLE 1. YOUNG CONTROL SUBJECTS EXPOSED TO HEAT.

Subject No.	Sex	Age	Height	Weight in Pounds	Percentage of Ideal Weight
1.	Female	21	5′ 2″	149.5	131
2.	Male	21	6′ 4″	163.5	88
3.	Male	25	6′ ¼″	160.0	96
4.	Male	25	5′ 6½″	137.0	100
5.	Female	25	5′ 6¼″	133.5	100
6.	Female	25	5′ 9″	175.0	118
7.	Male	26	6′ 1¼″	182.0	106
8.	Female	28	5′ 5″	115.0	90
9.	Male	29	5′ 8″	154.0	107
10.	Male	36	5′ 11½″	215.0	128
11.	Female	32	5′ 5″	136.0	106
12.	Female	36	5′ 4¾″	152.0	111

TABLE 2. AGED SUBJECTS EXPOSED TO HEAT.

Subject No.	Sex	Age in Years	Height	Weight in Pounds	Percentage of Ideal Weight	Clinical Findings	Comments	Degree of Debilitation
13.	M	95	5′ 5″	145	113	Generalized arteriosclerosis, cerebral arteriosclerosis, hemiparesis	Walks only with assistance, inactive, fairly well nourished	3
14.	F	93	5′ 1″	87	80	Senile psychosis, old hip fracture, arteriosclerotic heart disease, kyphosis, senile emphysema	Walks only with assistance, weak, inactive, poorly nourished	4
15.	F	82	4′ 11½″	137	136	Senile psychosis	Well nourished, active, ambulatory	1
16.	M	80	5′ 8½″	133½	92	Degenerative arthritis, generalized arteriosclerosis, arteriosclerotic heart disease	Thin, active, walks with crutches	2
17.	M	78	5′ 11½″	170	105	Traumatic arthritis of hip, old hip fracture, aortic enlargement, positive Kahn	Walks only with crutches, weak, inactive, fairly well nourished	3
18.	F	75	5′ 4½″	126	100	Hypochondriasis, old hip fracture, arteriosclerotic heart disease	Ambulatory, active, fairly well nourished	1
19.	M	74	5′ 2½″	106	92	Degenerative arthritis of hip and knees	Walks with cane, fairly active, thin, weak	2
20.	M	71	5′ 3¾″	115	93	Generalized arteriosclerosis, kyphosis	Ambulatory, weak, thin, inactive	2
21.	M	68	5′ 3½″	137	114	Senile psychosis, arteriosclerotic heart disease	Ambulatory, active, well nourished	1
22.	F	67	5′ 7½″	139½	99	Psychoneurosis, arteriosclerotic heart disease	Ambulatory, inactive, fairly well nourished	2
23.	F	61	5′ 2¾″	105½	90	Hypertension, hypertensive heart disease, hemiplegia	Walks only with assistance, inactive, poorly nourished	4
24.	F	61	4′ 11″	110	111	Senile psychosis	Ambulatory, weak, poorly nourished	2
25.	F	57	5′ 2″	120	105	Psychosis	Strong, active, well nourished	1
26.	F	57	5′ 1″	151	138	Feeble minded, kyphoscoliosis	Strong, active, well nourished	1

blood pressure, and in a few instances, surface temperature. The respiratory rate was determined from the tracing used in determining the oxygen consumption and the rectal and surface temperatures were obtained by the use of thermocouples which remained in place while the subject was in the cabinet. A standard type clinical thermometer which had been carefully calibrated was used to record the oral temperature. All of the subjects were exposed to heat for sixty to ninety minutes (except for subject No. 14) and, when necessary, exposure was terminated upon subjective distress.

RESULTS

Rectal temperature: The first change that was usually observed in rectal temperature upon closing the cabinet was a rapid fall of from 0.2 to 0.6 C., which was followed by a return to the initial level during the first five to fifteen minutes of heat exposure. In turn, this was followed by a progressive rise of

rectal temperature. This delayed onset of a rise in rectal temperature seemed to be more marked in the aged (fig. 1 and 2), and by the end of the first fifteen minutes a mean decrease in the rectal temperature was found of 0.04 C. in the aged and an increase of 0.23 C. in the young (see table 3). During the entire period of heat exposure there was an increase of rectal temperature in all subjects of from 1.0 to 2.0 C., except in 2 subjects (Nos. 20, 26) in whom there was slightly less than a 1.0 C. increase.

Following the termination of heat exposure (by opening the cabinet and exposing the subject to room temperature), the rectal temperature of all subjects remained at the same height as that just prior to opening the cabinet or continued to rise a few tenths of a degree, and there was a delay of ten to thirty minutes before the rectal temperature began to fall. In contrast to this was the more immediate onset of a decrease in oxygen consumption, pulse rate, oral temperature, and respiration rate which frequently occurred within five minutes after opening the cabinet. In a few subjects, in whom the surface temperature was

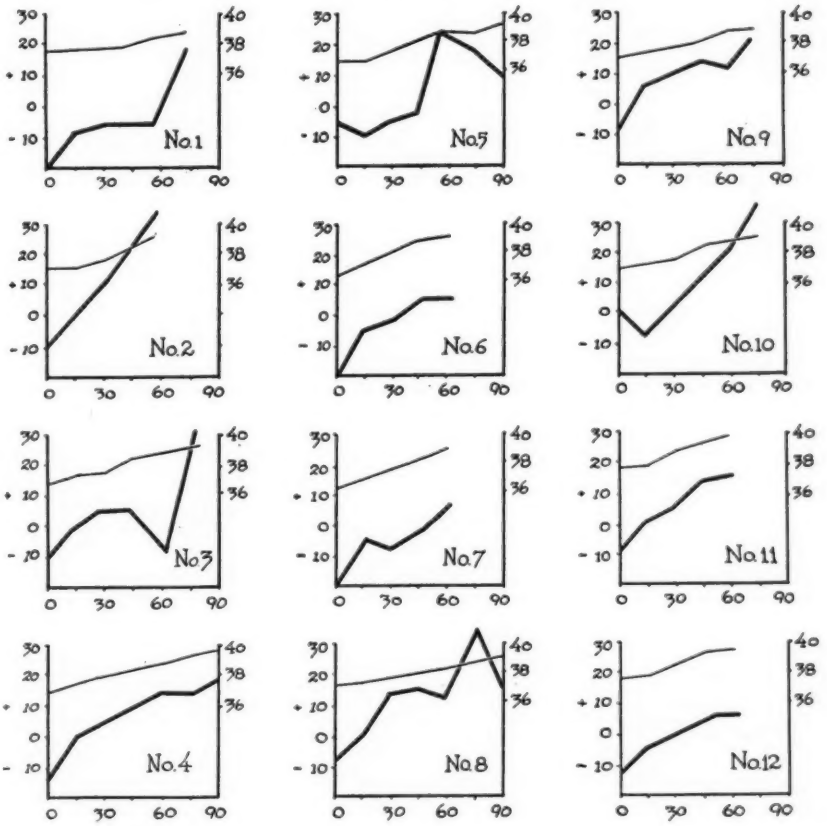

FIG. 1. Young Subjects. Oxygen consumption and rectal temperature changes of each subject during heat exposure for varying lengths of time. For identification of components of graph see fig. 2.

taken of various parts of the body, there was noted a simultaneous rapid decrease in surface temperature most marked at the peripheral areas of the body.

Whereas in the young there was a mean delay of 12.9 minutes before the rectal temperature began to fall (standard error 1.14) there was a greater delay in the aged (mean 21.2

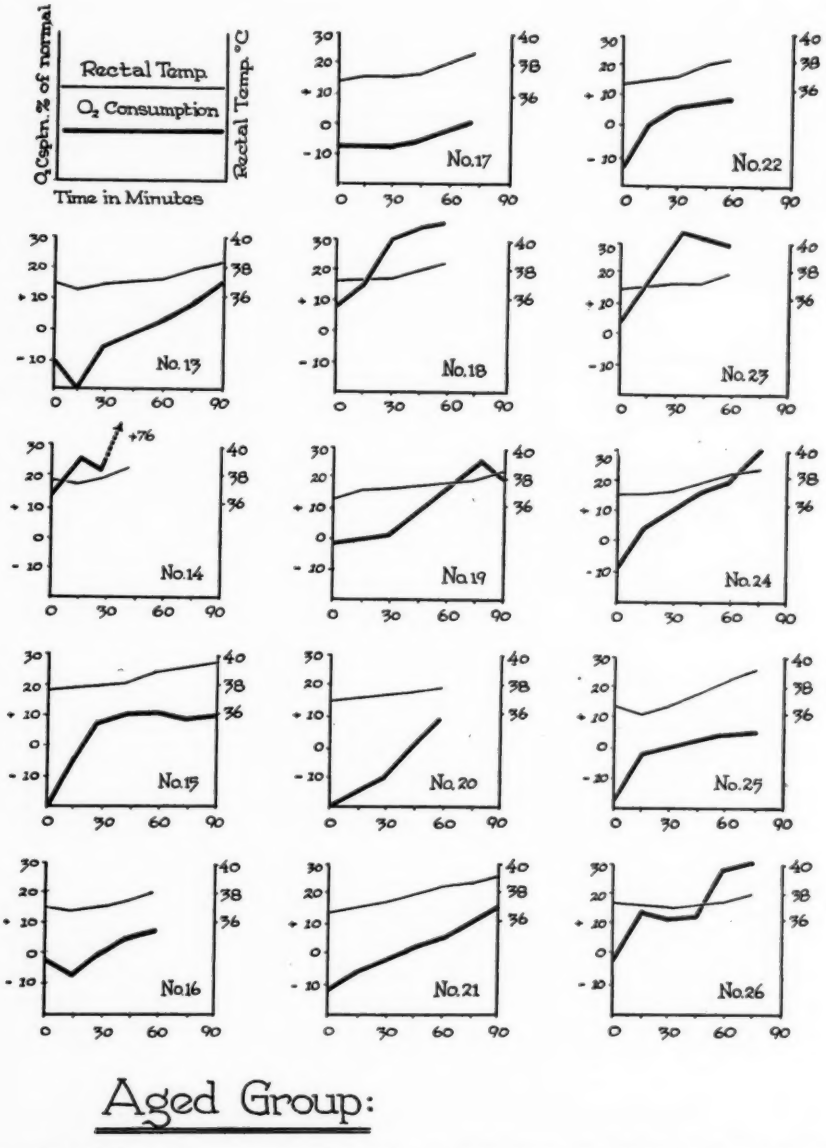

FIG. 2. Aged Subjects. Oxygen consumption and rectal temperature changes of each subject during heat exposure for varying lengths of time. Labeling of components of graphs is shown in upper left corner of figure.

minutes, standard error 2.25). Evaluation of this data revealed a statistically significant difference between the young and old (t test 3.34).

A similar difference in the recovery time of oral temperatures was also noted between the young (mean 30.5 minutes, standard error 1.84) and the aged (mean 36.5 minutes, standard error 1.84; t test 2.3).

Pulse rate: The pulse rate increased with heat exposure, in both the aged and in the young (table 3 and fig. 3). A mean increase of 18.5 beats per minute for one degree C. rise in rectal temperature was found in the aged and 22 beats per minute in the young. In figure 3 are presented coefficients of correlation between rectal temperature change and pulse rate. These were found to be 0.84 in the young, 0.82 in the nondebilitated aged, and 0.45 in the debilitated aged subjects. When the debilitated and nondebilitated aged subjects are compared (fig. 3) it may be seen that whereas the response of the nondebilitated was quite similar to that of the young, the debilitated show a lower pulse rate and a low degree of correlation.

Electrocardiographic changes: No significant electrocardiographic changes were observed except for shortening of the T-P interval and occasional premature systoles. These

TABLE 3. CHANGES IN RECTAL TEMPERATURE, PULSE, AND RESPIRATORY RATE IN YOUNG AND OLD SUBJECTS FOLLOWING EXPOSURE TO HEAT.

	0 Minutes	15 Minutes	30 Minutes	45 Minutes	60 Minutes
Rectal Temperature in Centigrade					
Young (12 Subjects)					
Mean	37.13	37.36	37.80	38.38	38.80
S.D.	0.26	0.26	0.36	0.53	0.64
S.E.	0.08	0.07	0.10	0.15	0.18
Aged (14 Subjects)					
Mean	37.15	37.11	37.34	37.71	38.15
S.D.	0.28	0.29	0.30	0.31	0.37
S.E.	0.08	0.08	0.08	0.08	0.10
t Test	1.86	2.32	3.51	3.89	2.93
Pulse Rate per Minute					
Young (12 Subjects)					
Mean	68.2	77.8	89.5	104.2	111.7
S.D.	4.71	5.29	12.0	17.2	14.3
S.E.	1.36	1.53	3.46	4.96	3.28
Aged (14 Subjects)					
Mean	71.2	77.3	81.5	91.1	100.3
S.D.	7.30	9.30	9.2	11.6	13.6
S.E.	1.95	2.49	2.52	3.10	3.78
t Test	1.26	0.17	1.87	2.24	2.28
Respiratory Rate per Minute					
Young (12 Subjects)					
Mean	10.7	11.7	13.0	14.5	18.2
S.D.	4.0	4.4	5.0	5.0	7.5
S.E.	1.1	2.0	2.3	2.3	2.2
Aged (14 Subjects)					
Mean	16.7	18.5	20.0	21.7	22.3
S.D.	4.2	4.5	5.1	6.6	6.3
S.E.	1.1	1.2	1.4	1.8	1.7
t Test	3.75	2.92	2.64	2.50	1.47

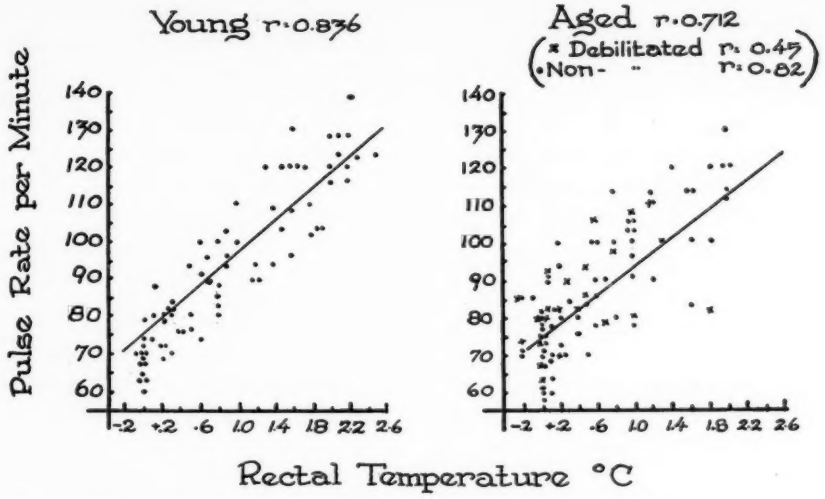

FIG. 3. Scatter diagram showing the relationship of pulse rate to increased rectal temperature in young and aged subjects during exposure to heat. r = coefficient of correlation.

changes paralleled the increase in pulse rate, occurred in both young and aged subjects, and subsided upon the recovery of a normal body temperature.

Respiratory movements: A higher rate of respiratory movements was noted in the aged than in the young under basal conditions as well as following heat exposure (table 3). These differences appeared to be statistically significant.

Oxygen consumption: The rate of oxygen consumption increased in all subjects upon heat exposure; however, in some instances this increase was not uniform (figs. 1, 2). The mean increase at fifteen minute intervals for the 2 groups of subjects (old and young) are shown in table 4. As may be seen, two methods of expressing the oxygen consumption are presented. The first method, percentage of normal basal metabolic rate (B.M.R.), shows a mean metabolic rate at the end of sixty minutes of + 11.8 per cent in the young and + 13.8 per cent in the old. Statistical evaluation of this data, however, failed to demonstrate any significant difference between the young and old.

The second method presented of the expression of oxygen consumption, total oxygen consumption, was estimated by use of paper replicas. These were constructed by plotting upon graph paper each determination of the rate of oxygen consumption in cc. oxygen per square meter surface area per minute for each subject in a manner similar to that shown in figs. 1 and 2. The total amount of oxygen consumed (cumulative volume) at the end of each fifteen minute period of heat exposure was determined by estimation of the area covered by the rate curve and this data was subjected to statistical evaluation. A distinction was made between the quantity consumed under basal conditions and the increase above this due to heat exposure.

It may be seen in table 4, as would be expected, that under basal conditions the oxygen consumption in the young was greater than in the aged. It may also be seen that there was a greater mean consumption of oxygen upon heat exposure in the young when compared to the aged. Thus, at the end of sixty minutes, there was an increase above the basal level of 1,290 cc. in the young and 923 cc. in the aged. Statistical evaluation of this data is presented and reveals a low degree of significant difference between the young and old.

An attempt was made to distinguish any

TABLE 4. CHANGES IN OXYGEN CONSUMPTION OF YOUNG AND OLD SUBJECTS FOLLOWING EXPOSURE TO HEAT.

	0 Minutes	15 Minutes	30 Minutes	45 Minutes	60 Minutes
Rate of Oxygen Consumption (B.M.R.) in Percentage of Normal					
Young (12 Subjects)					
Mean	−11.3	−2.4	+3.6	+7.6	+11.8
S.D.	6.2	4.3	7.4	8.1	12.2
S.E.	1.8	1.2	2.1	2.3	3.5
Aged (14 Subjects)					
Mean	−5.6	+1.0	+6.7	+14.4	+13.8
S.D.	11.1	13.2	13.7	21.6	12.8
S.E.	3.0	3.5	5.8	5.8	3.6
t Test	1.65	0.91	0.50	1.09	0.40
Total Oxygen Consumption					
a). Basal Consumption, Cumulative Value (in cc. Oxygen Consumed Per Square Meter of Surface Area at the End of Various Periods of Heat Exposure).					
Young (12 Subjects)					
Mean	.....	1,694	3,391	5,091	6,794
S.D.	.....	130	266	404	321
S.E.	.....	38	77	116	97
Aged (14 Subjects)					
Mean	.....	1,583	3,170	4,764	6,282
S.D.	.....	190	381	568	729
S.E.	.....	51	102	152	202
t Test	.....	1.73	1.74	1.71	2.31
b). Increase Above Basal Consumption, Cumulative Value (in cc. Oxygen Consumed Per Square Meter of Surface Area at the End of Various Periods of Heat Exposure).					
Young (12 Subjects)					
Mean	.....	125	413	801	1,290
S.D.	.....	105	259	464	694
S.E.	.....	30	75	134	200
Aged (14 Subjects)					
Mean	.....	78	275	566	923
S.D.	.....	69	228	394	588
S.E.	.....	8	61	105	163
t Test	.....	1.14	1.43	1.38	1.42

differences in oxygen consumption between the debilitated and nondebilitated aged subjects. Statistical evaluation of the data, however, failed to reveal any differences in oxygen consumption between these 2 groups using these two methods of expressing oxygen consumption. It should be pointed out, however, that only 4 debilitated subjects were included in this study, and for this reason conclusive data are not available.

Relationship of body temperature to oxygen consumption: When the changes in mean rectal temperature and oxygen consumption at fifteen minute intervals of heat exposure (tables 3 and 4) were related to each other it was found that a statistically significant difference between the young and old could not be demonstrated by this method.

If, instead of basing the relationship between rectal temperature and oxygen consumption upon the calculated mean values given in tables 3 and 4, a scatter diagram is constructed from the individual data a somewhat different picture may be seen (fig. 4). Thus, when the rate of oxygen consumption was expressed both in cc. oxygen per square meter of sur-

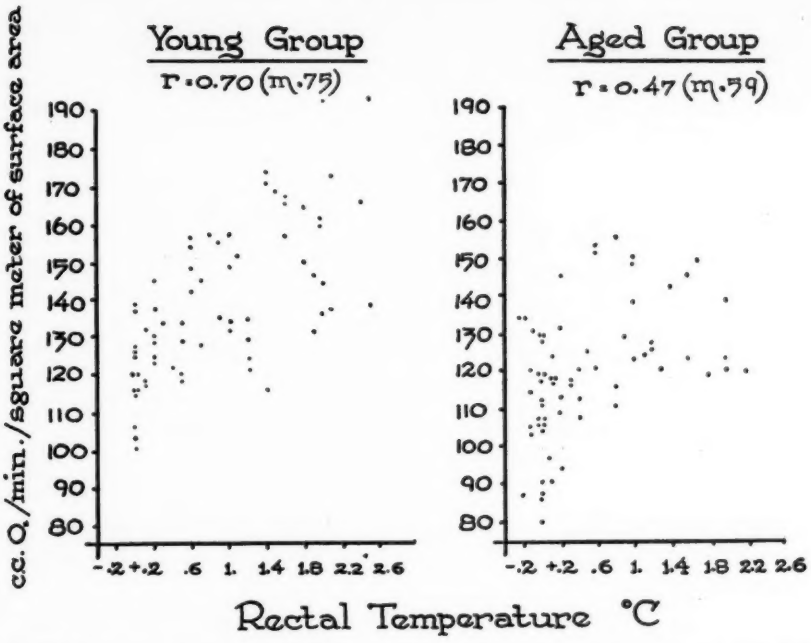

FIG. 4. Scatter diagram showing the relationship of oxygen consumption to increased rectal temperature in young and aged subjects during exposure to heat. The symbol r represents coefficient of correlation and m correlation ratio.

face area and percentage of normal B.M.R., it was found that, for a 1.0 C. increase in rectal temperature, there was a slightly greater mean increase in oxygen consumption in the young when compared to the old, + 14.0 per cent or 18.0 cc., and + 13.0 per cent or 13.0 cc. in the aged. This difference between the 2 age groups was more marked at temperatures above 1.0 C. Coefficients of correlation in the young were 0.70 and 0.76 when the oxygen consumption was expressed in terms of cc. oxygen per square meter of surface area and percentage of normal, respectively. In the aged, these were 0.47 and 0.51. Thus, as shown in fig. 4 not only is there a greater variability in the response of the aged, but also a smaller increase in the rate of oxygen consumption, particularly at temperatures above 1.2 C.

DISCUSSION

The effect of generalized heat applied to the body has been well studied (1, 2, 3, 7, 8, 9, 10). Considerable data on man has been collected during studies of the effect of fever therapy on arthritis and syphilis of the nervous system, in which case the body temperature is elevated to 102 to 106 F. (39 to 41 C.) and maintained at this level for several hours. Patients undergoing vigorous therapy of this type must be carefully selected and older individuals are rarely considered candidates for this procedure. Patients studied in this report were suffering from diseases associated with old age, and for this reason these subjects ordinarily would not be considered as suitable for fever therapy. The duration and height of fever in this study, however, was considerably less than that used ordinarily for therapeutic purposes and was well tolerated in most instances. Occasional untoward reactions in both young and old occurred after raising the temperature more than 1.5 C. and were characterized by confusion, apathy, excitement, and such findings as tachycardia, vasodilation of the skin, and rapid and

shallow respiration, all developing rapidly and subsiding within one or two minutes after opening the cabinet. In no instance were any undesirable after effects noted, and in a few instances arthritic complaints were lessened.

The initial transitory decrease in rectal temperature upon exposure to heat is apparently secondary to vasomotor changes resulting in a large volume of cooler peripheral blood entering the general circulation. Whether or not age differences influence this cannot be stated with certainty from this study, although the observation made would indicate that this response may be more prolonged in the aged.

Upon terminating heat exposure, the delayed fall in rectal temperature compared to the more rapid decrease in the pulse, respiratory rate, and oxygen consumption, which has been noted by others (8, 10), is apparently due to cooling of superficial peripheral tissues that occurs upon exposure to the cooler air of the room. The deeper tissues such as recorded by rectal thermometers require more time to return to normal, and in the aged the time required for this was apparently greater than that taken by the young.

That the pulse rate increases with an increase in body temperature is, of course, well known. It is usually stated that for every degree F., the pulse increases 5 to 10 beats per minute. Similar increases have been found during artificial fever (7) but only after the temperature has become stationary at high levels. During the time that the body temperature is rising, higher pulse rates have been found, usually 16 to 24 beats per minute per 1.0 C. (1). To some extent, this is dependent upon anoxia as pointed out by Cullen, Weir, and Cook (2), who found a higher pulse rate in subjects who did not receive oxygen during fever therapy when compared to those who did receive oxygen.

In this study, a higher mean pulse rate was observed in the young than in the aged after 45 to 60 minutes of heat exposure (table 3); however, it should be pointed out that at the same time the rectal temperature was higher in the young. When the rectal temperature and pulse rates shown in table 3 are related to each other, no statistically significant difference could be demonstrated between the young and old. However, when the individual data were plotted on a scatter diagram (fig. 3) in addition to finding a slightly higher rate in the young (22 per minute per 1.0 C.) than in the aged (18.5 per minute per 1.0 C.) a greater degree of correlation between the pulse and temperature was found in the young (0.84) than in the old (0.71). Comparison of the debilitated subjects and the nondebilitated subjects (fig. 3) shows a lower pulse rate in the debilitated and a low degree of correlation (0.45) between the pulse and temperature. In addition, it will be noted that the degree of correlation between pulse and temperature of the nondebilitated aged subjects is 0.82, which is quite close to that observed in the young, 0.84.

A significant difference between the young and old as well as the debilitated and nondebilitated aged subjects was noted in the rate of respiratory movements (table 3). Under basal conditions, the rate was lowest in the young and highest in the debilitated aged subjects. Likewise, the greatest increase following 1.0 C. rise in rectal temperature was noted in the debilitated and the smallest increase in the young. It should be pointed out, however, that these differences may in part be due to the fact that among certain of the aged subjects diseases such as emphysema were present, which often result in a higher rate of respiration.

It has been recognized for many years that the rate of oxygen consumption increases with an increase in body temperature (3, 4). The data presented here of an increase of approximately 13 per cent in the rate of oxygen consumption per degree C. rise in rectal temperature is in agreement with the reports of others (1, 4, 10).

The increased rate of oxygen consumption by the aged in this study was found to be quite close to that found in the young. Attempts to show any difference between the young and old are difficult due to the complexity of tech-

niques in measurement and individual variability. Thus, simply finding that at fifteen minute intervals there was a greater mean increase in oxygen consumption by the young than by the old is misleading, since at the same time there was also a significantly greater increase of rectal temperature in the young. Directly relating the rectal temperature to increased oxygen consumption, using the data on tables 3 and 4, revealed no obvious differences between the young and old. However, plotting the individual data on a scatter diagram (fig. 4) and then determining the correlation ratios and the coefficients of correlation, one finds that there is a slightly greater increase of oxygen consumption in the young, particularly at temperature increases above 1.0 C., as well as a greater degree of correlation between oxygen consumption and rectal temperature.

Summary

Fourteen aged subjects 57 to 95 years of age and 12 young control subjects were exposed to heat (38 to 45 C.) for a period of sixty to ninety minutes. Rectal temperature, oral temperature, pulse rate, respiration, and oxygen consumption were measured before and during the exposure. The results indicated that although the aged withstood the exposure fairly well, their response in terms of changes in pulse rate and oxygen consumption was more variable than that observed in the young.

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Geriatric Management of Prostatism

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DORLAND'S MEDICAL DICTIONARY defines prostatism as "a morbid state of mind and body due to prostate disease, especially the condition which results from obstruction to urination due to prostatic hypertrophy."

The morbid state of mind more frequently holds with the geriatric patient, already burdened with other health problems, when he becomes further afflicted by an obstruction to urination. His worry is best relieved by correcting an idea of exaggerated importance, which he often erroneously attributes to the prostate gland. In particular, we should discuss with him its importance to sex, vitality and longevity, and kidney function. Many patients think bladder dysfunction means kidney disease. We should inform them that the prostate is not a sex gland, that men retain their vitality and do not age more rapidly after prostatectomy, and that kidney damage of progressive type due to prostatic obstruction of the bladder is found with decreasing frequency today because of earlier diagnosis and therapy. Frequently the morbid importance attached to prostatic hypertrophy (more accurately hyperplasia) (2), becomes less when the patient learns that his obstructive symptoms are caused in great part by a failing bladder musculature (4), which may be improved, and not entirely by dangerous changes in the prostate.

The state of mind of our geriatric patients is not entirely due to fear of a diseased prostate itself. There also is a fear of diagnosis, examination, and of prostatectomy possibly followed by impotence and incontinence of urine. The answer to these worries is that the diagnosis very frequently can be completed without pain and without catheterization or immediate cystoscopic examination; that we can first determine whether these procedures are necessary and then later, when the patient is anaesthetized, add them to any indicated surgical procedure at the time of operation. It is frequently wise to traumatize only once and immediately thereafter institute free drainage of urine. Impotence and incontinence, postoperatively, occur very infrequently today when not present before operation. It is unusual when some form of prostatic surgery cannot be beneficially offered to any geriatric patient.

Micturition.—Micturition (4, 5) is a voluntary-involuntary reflex. The voluntary portion is brought about in large part by the perineal muscles which drop slightly and so straighten the posterior urethra and directly assist in opening the internal (bladder) and indirectly the external (urethral) sphincter. These changes allow urine to enter the posterior urethra where it stimulates an involuntary contraction of the bladder wall. The muscles below and within the fascia planes of the urogenital trigone compress the membranous urethra; the fascia planes with these muscles strongly fix this structure against the pull of the anterior perineal muscles, otherwise the entire urethra would be pulled up and down and stretched by the strong perineal muscles.

A complete urologic examination will readily determine which structure is primarily responsible for a break in the normal reflexes of micturition, and from this we can deduce the secondary changes which contribute to dysurias.

Diagnosis.—The diagnosis begins with observation of the patient, his gait, nutrition, muscle tone; for whenever the tone of any skeletal muscles is changed a corresponding change could be present in perineal muscle function, which is so important in bladder control. Our examination specifically searches for

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corroborating evidence of a mental or neuromuscular change from normal. We keep in mind that aging processes alone, anemias, diabetes, nutritional diseases, as well as diseases of the nervous system, can affect the reflexes of micturition and stimulate or contribute to bladder obstruction or to urinary incontinence. A patient with controlled cardiovascular disease tolerates prostatectomy very well; relief of the prostatic obstruction does not directly improve the cardiovascular disease. Cardiac deaths during or from prostatectomy very infrequently occur.

History.—Our interest lies in analyses of symptoms and their duration, those that are progressive and those more or less stationary.

Symptoms of urinary obstruction follow a pattern which parallels the balance of power between the bladder wall and obstruction to its outlet. The obstruction may or may not be caused by the prostate alone. In the geriatric patient we may have bladder obstruction or incontinence of urine primarily associated with altered mental or neuro-(perineal) muscular control. An acute cystitis increases the expulsive force of the bladder, although often only temporarily, as does loss of inhibition, or central nervous system irritability. On the other hand, a long continued high intracystic pressure and/or the weight of a residual bladder urine eventually decreases, by pressure anaesthesia, the force of bladder wall contraction. This is a physiologic adaptation. The posterior urethra will, by loss of perineal support, irritability, or loss of normal sensory response, either increase or decrease the involuntary urethro-bladder reflex. A relaxation of the voluntary sphincter muscles frequently causes these people to soil their clothes since with these atonic muscles they are unable to finally terminate urination, an act which requires a firm upward pull by the perineal muscles.

As long as a bladder musculature can overcome a urethral obstruction it will thicken (compensate) and correspondingly lose capacity, which means frequency and progressive urgency of urination, even to an associated incontinence of urine.

Nocturia is one of the early and disturbing symptoms of bladder obstruction. An explanation is that sleep relaxes the perineal muscles and so allows the internal bladder orifice to drop slightly to its voiding position where it and the proximal posterior urethra will be stimulated by the high pressure of the compensating bladder wall. This stimulation is similar in effect to that of urine normally allowed to enter the posterior urethra; either stimulates a detrusor bladder action. Often in these cases, when the patient awakens fully, the desire to void will stop as the tone of the perineal muscles then returns, and the internal orifice and posterior urethra will again assume their normally elevated (urine retaining) position. Later an accumulation of a residual urine with its associated decrease in sensory response may relieve the nocturia. Incontinence of urine in senescence may be due to a decrease in bladder wall thickness (a decompensation), with a residual urine, and an overflow type of incontinence.

The start, flow, and abrupt stop of the urinary stream is visual evidence of bladder wall expulsive force against the total resistance of the sphincters, to which a prostatic obstruction may be added.

Urine Examination.—The presence or absence of infection of either the urethra alone or of the urethra and bladder, in the latter case an infection of the urine itself, can best be determined by a methylene blue stain of centrifuged urine specimens from both freshly voided glass I and glass II. Culture of urine should be used to identify the organism and possibly to verify the results of the methylene blue stain. When we rely on culture alone, contamination and failure of organisms to grow even when they can be demonstrated microscopically result in a rather high percentage of error. Gross or microscopic blood in the urine is of great importance and often indicates that a complete urologic investigation will be necessary.

Rectal Examination.—Rectal examination will differentiate the benign from malignant prostate in a high percentage of cases. An early carcinoma or the histologically demonstrable carcinoma of the prostate—conveniently designated as "latent carcinoma or occult carcinoma" (2) is found more frequently when the entire prostate is sectioned at autopsy than from study of hyperplastic tissue removed by prostatectomy; nor do a large percentage of our patients develop carcinoma post-operatively. The latent carcinoma must, therefore, remain latent in many instances. For this reason urologists may not favor androgen therapy.

The Papanicolaou test, examination of expressed fluid for malignant cells, is not as reliable as examination of tissue obtained by surgical biopsy. The frozen section is not always satisfactory for microscopic diagnosis.

On rectal examination a spastic anal sphincter denotes a spastic perineum, which alone may obstruct the bladder by elevating the bladder orifice; more often such a change in the voluntary sphincter will add to a prostatic bladder obstruction. Loss of sensation, rectal and urethral, may be the sole obstruction to the bladder. In these cases the bladder wall loses its detrusor stimulation reflex from the urethra, and therefore it may become decompensated (thinned) by the weight of a residual urine, and later from scar tissue throughout the bladder wall muscle, resulting from infection. In a few instances, touching the anal sphincter will reflexly produce either an active dilatation or spastic changes of the anal canal. These cases need a neurologic investigation.

The presence of *residual urine* does not definitely indicate the necessity for prostatectomy; even in the aged individual a residual urine may vary, in fact disappear for periods. When the urine is not infected, the bladder function quite satisfactory, and the upper urinary tract not unduly influenced by bladder wall changes or by reflux up the ureter, it may be best not to advise prostatectomy. In these cases the uninfected residual urine should not be removed by catheter, at least not until the urologic diagnosis is complete and an opinion formed that prostatectomy is necessary. The danger of infection is not derived from a contaminated catheter but from passing a clean catheter over a posterior urethra, where bacteria are found upon and within many of the epithelial cells; these epithelial cells and bacteria may be carried into an uninfected residual urine. Also the mild trauma of one catheterization may exacerbate a dormant urethral infection. A sizable residual urine, without infection, in certain geriatric patients who should not be operated upon, may be preferable to a smaller infected residuum. Also the acquired infection may need prostatectomy for its cure, or we may be faced with the necessity for an indwelling catheter.

Intravenous pyelograms.—Intravenous pyelograms often are unsatisfactory for an accurate pyelographic diagnosis. Their value always lies in the plain film and in showing us the comparative functional ability of the right and left kidney to excrete iodine. In a certain number of cases (not over 30 per cent) we may have a complete visualization of the *entire* urinary tract. Even so, in a far greater percentage they are sufficient to show whether an upper urinary tract is satisfactory or not for prostatic surgery. They will usually show any dilatation of the ureter, indicating that the bladder wall is obstructing the upper urinary tract. This should be known from a treatment standpoint, as emptying the bladder may increase this block, and ureteral catheter drainage temporarily become necessary.

Intravenous pyelograms do not stop peristalsis of the pelvis and calyces as do retrograde pyelograms. Therefore, the same major or minor calyx repeatedly may not fill, due to a peristaltic "systole." This may suggest a pathologic condition of the kidney. In these cases retrograde pyelograms will fill all of the normal calyces. Very often one bilateral retrograde pyelogram supplementing the intravenous pyelogram is sufficient. A residual urine determination is important in these cases and may be obtained at the time of intravenous pyelography when immediately after the final film we have the patient empty his bladder and im-

mediately make a cystogram, which will show retained urine. The amount of retention can be estimated. This test eliminates the necessity for catheterization.

Although a retrograde pyelogram may be necessary, it is unwise to pass ureteral catheters, particularly when the bladder urine is infected, and when the history does not suggest a kidney involvement.

Very recent work (7) shows that by using a larger amount of X-ray opaque medium (Urokon) we can obtain an improved pyeloureterogram, cystogram, nephrogram, visualization of the renal arteries, a kidney function estimation, and in many instances an incidental cholecystogram. It is hoped that this procedure will definitely reduce the necessity for cystoscopic examination in many cases.

Cystoscopic examinations.—Cystoscopic examinations, particularly in the geriatric patient, should be carried out under a satisfactory anaesthetic, after it has been determined that surgery is indicated and will be well tolerated. At this time the choice of operation and any unexpected procedure may be performed. By this method we furnish free drainage immediately after the operation, preventing an exacerbation of infection which can follow instrumentation, particularly when there is a lapse of days between the cystoscopic examination and the establishment of free urinary drainage. Failure to recognize these factors will increase the surgical mortality rate, especially in the poor risk geriatric patient.

Cystometry (6) is used to differentiate a neurogenic from a physical bladder obstruction, to diagnose bladder function and, therefore, to explain bladder symptoms. A cystometer simultaneously records and associates bladder capacity, intracystic pressure, sensations of bladder filling, and ability of the sphincters to resist detrusor bladder action.

Nesbit (3) recently has shown that an atonic bladder which will not return to voiding strength after a retention catheter for a few days will not empty itself after surgical removal of the obstructing prostate. This information is obtained by comparing cystometrograms made before and after the retention urethral catheter is used.

Treatment.—In this paper we are discussing a person who suggestively needs a prostatectomy for relief from his distressing symptoms caused by a compensated or decompensated bladder, with a possible associated infection, but who does not require surgery from the standpoint of marked prostatic obstruction. Prostatectomy and the choice of operation presents many problems. Partial relief by palliative surgery never is indicated. The obstruction should be completely removed in all instances.

Cowdry (1) mentions that the prostate "stands before the bladder" (Greek *prostates*, one standing before) and that it "is almost unique among glands in its tendency to undergo benign hypertrophy in advanced years. This enlargement is statistically normal because R. A. Moore, 1942, gives its incidence as well over sixty percent in individuals over sixty years of age." These statements definitely show that we do not operate on a large percentage of those obstructed and also that the prostate "standing before the bladder" is an ever-present consideration in all dysurias. I believe it should share responsibility in these cases with the bladder wall, which at times lends itself to treatment other than surgical.

We frequently see an acutely overdistended bladder resume its function satisfactorily after a single catheterization. Lesser degrees of bladder muscle decompensation may be corrected for various periods of time. The size of the obstructing prostate temporarily may be reduced without surgery, which may, in some cases, improve symptoms by relatively increasing the expulsive force of the bladder wall over the resistance of the obstructing prostate. Great relief in all early cystitis cases and particularly those with thick, compensated bladder walls, may be obtained with the antibiotics; however, it usually is impossible to cure a cystitis as long as a bladder residual urine remains.

Prostatic massage.—Prostatic massage can relieve bladder obstruction in a few instances.

Retained prostatic secretion in dilated acini alone or in association with an infection, when reduced in amount by two or three prostatic massage treatments, and an antibiotic to control the infection, which also could be exacerbated by the mild trauma of the massage, will at times materially reduce the size of the prostate. In many cases even though the prostate is reduced in size, the bladder obstruction will not be relieved. When massage of the prostate ceases to reduce the size of the gland the treatment should be discontinued.

As a residual bladder urine tends to increase in amount and its presence to decrease the strength of bladder muscle contraction, every effort should be made by the patient to completely empty his bladder, particularly at the first voiding in the morning. The efforts should include time, that is, repeated attempts to void, standing or sitting. Bending the body forward when sitting, even to a degree that will require resting the arms upon a stool, will tip the bladder outlet downward—something like pouring from a teakettle with an outlet above its base—and effect a more complete emptying. While bent over, pressure by the fist, a wadded towel, or a small, firm pillow, between the suprapubic area and the toilet seat, may help considerably. These efforts should be made only after a urologic evaluation has been made.

Nocturia can be relieved to some extent by management of bowel elimination, a bowel movement before retiring. Anal fissures and painful hemorrhoids should be relieved. Sensations of the rectum, anal canal, and bladder and posterior urethra are closely associated. Tap water enemas or glycerine suppositories often give relief. Flatus or pressure of a full rectum upon the base of a compensated bladder musculature, and transmitted to the proximal posterior urethra will increase nocturia. Nocturia may be reflex from pressure by lobes of the prostate protruding into its urethra. Small masses of prostatic tissue left after a transurethral prostatectomy may have the same effect. For this type of nocturia 50 mg. of Benadryl, by its antispasmodic action, may give relief. Close watch must be kept for the return of an infection in these cases, as Benadryl then will fail to relieve.

Drugs that increase the force of bladder contraction are not used with prostate bladder obstructions, except when a urologic or other postoperative inhibition accounts for the urinary retention (5).

Reducing the intake of fluids in the afternoon and evening and increasing the morning intake in some instances will decrease the nocturia. In some cases there is a greater output of urine during the night than during the day. Therefore, measurement of the twelve hour output of urine may be indicated. Often additional information can be obtained by requiring the patient, for a short time, to measure and record each voiding during the night.

The atonic neurogenic bladder can be repeatedly catheterized with much less danger to the patient than the spastic neurogenic or the physically obstructed bladder. In some atonic neurogenic bladder and urethra cases the results of transurethral resection of the prostate are not as satisfactory—when the reflexes of micturition are impaired—as continued self-catheterization by the patient. In these cases a large remaining residual urine, when not occasionally removed, may by vicious circle increase in amount, and a distressing incontinence result.

Summary

Benign prostatic hypertrophy at times may be considered in the aged as a complex, mental-bladder obstruction, disease. Relief of the mental side, described as a morbid state of mind, is accomplished by discussing with the patient the function of the prostate gland and its relationship to sex, vitality, longevity, and kidney function. The bladder obstruction usually does not present undue difficulties in its removal, but when symptoms are not too severe, symptoms of obstruction may be ameliorated by instructing the patient regarding bladder function and management of bladder musculature for better detrusor ability.

Symptoms are explained to the patient on a basis of simple bladder function. Diseases are discussed which may be the primary geriatric problem and contribute to symptoms of prostatic obstruction.

A method of diagnosis is presented which will furnish an adequate diagnosis and allow omission of preoperative instrumentation.

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Retirement Practices in Business and Industry

JACOB TUCKMAN AND IRVING LORGE

As part of a broader research project concerned with adjustment before, at, and after retirement, a survey of large corporations was conducted by questionnaire to determine the current practices in business and industry pertaining to retirement of employees.

The questionnaire sought information in three broad areas. The first part of the questionnaire was concerned with pension plans because the drive for pensions during the past three years has focused attention sharply on the entire problem of financial security in old age. The pension issue is no longer *if* but *how much*. The second part of the questionnaire attempted to obtain information on the psychologic reactions of older employees. While the importance of economic security cannot be denied, there are other equally pressing social and psychologic problems which confront the older employee approaching retirement. The third part of the questionnaire sought information on the type and extent of assistance given by corporations to help prepare employees for the variety of problems they may have to face on retirement.

A copy of the questionnaire used in this survey follows:

SURVEY OF RETIREMENT PRACTICES IN BUSINESS AND INDUSTRY

1. Name of company ——————————
2. Number of employees: Men——— Women———
3. Does your company have a pension plan for its employees? ——Yes ——No
4. Please check if it covers: ——Shop personnel ——Executive and office personnel ——All personnel
5. Please check if your pension plan is: ——Wholly financed by the company ——Contributed to by employees
6. Does the plan link benefits with social security? ——Yes ——No
7. At what age is retirement compulsory? ——For men ——For women
8. If retirement is optional, what is age? ——For men ——For women
9. How many employees were retired last year? ——Men ——Women
10. Among your older employees, do you find a fear of aging and being unable to keep up with younger workers? ——Yes ——No
11. Does your company give any special attention to older employees to help them overcome this fear and keep production high? ——Yes ——No
12. Have you found it necessary to make special provisions for older workers such as lighter jobs, less responsible jobs, reduced hours, etc.? ——Yes ——No
13. Do you find that workers become anxious and worried as they approach retirement age? ——Yes ——No
14. Does your company have any program, formal or otherwise, to help prepare its employees for the problems they will have to face upon retirement? ——Yes ——No
15. If answer to question 14 is Yes, please check which of the following are covered by your program: ——Physical problems of aging and steps to maintain health ——Financial adjustments ——Insurance, hospitalization, and surgical benefits ——Housing and living arrangements ——Outside activities and hobbies which may become revenue producing ——Leisure time and recreation ——Family adjustments ——Other (Please specify)
16. To what age groups is the program geared?——
17. What media are employed? ——House organ ——Group discussion ——Individual counseling ——Other (Please specify)
18. There has been a growing criticism of the use of age as the basis for retirement. Instead, it has been suggested that the decision to retire an employee should be based only on the physical and mental ability to do the job. Do you agree with this suggestion? ——Yes ——No
19. May we have the reasons for your reply to question 18?

The questionnaire was sent to the 113 largest corporations in the United States in October, 1950. The list supplied by Poor's Register of Directors and Executives included 39 industrials, 16 utilities, 16 banks, 21 insurance com-

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panies, and 21 railroads. We selected these corporations for study not because they necessarily have better pension plans or more adequate pre-retirement programs than intermediate and small companies but because they are large employers of large numbers of people and have had to meet the impact of the drive for pensions on the part of organized labor during the past two years. We consciously left out of consideration the retirement practices of government—city, state, and federal.

Replies were received from 74 corporations. Four, 1 of which believed that its company was not representative of the particular industry, were unwilling to participate in the survey. The 70 companies that answered the questionnaire represent a 62 per cent return and employ 2.75 million workers. We did not obtain a complete return nor did we expect it. The returns seem to under-represent utilities and railroads, but do represent the range of industrial, bank, and insurance companies to which the questionnaire had been sent. It is possible that the companies that failed to respond to the questionnaire did not have any retirement programs in operation or were not sufficiently interested in the problem of retirement. The data, at best, in so far as they constitute a biased sample, are suggestive of contemporary practice. An analysis of the returns by the type of business or industry is given in table 1.

Pension Plan Coverage

All the respondents reported that they have a pension plan for their employees. With the exception of 1 insurance company where only executive and office personnel are covered, these plans cover all employees. Several of these plans were instituted during the past year, one as late as October, 1950.

The types of pension plans in operation in the companies surveyed are shown in table 2. Forty-six per cent of the respondents have noncontributory plans, i. e., wholly financed by the company; 53 per cent have plans to which the employee contributes; 1 per cent have both types of plan in operation. Utility companies and industrials operate under non-contributory plans to a greater extent than do insurance companies and banks. Sixty-seven per cent of utility companies and 58 per cent of industrials have noncontributory plans as against 44 per cent of insurance companies and 36 per cent of banks. None of the railroads operate under a noncontributory plan since employees of railroads are covered by the Railroad Retirement Act which requires joint contributions on the part of employer and employee.

Sixteen per cent of industrials and 88 per cent of railroads have supplementary pension plans for certain categories of salaried workers or for those earning above a certain amount a month. This amount varies from $250 to $400 a month for industrials and in excess of $300 a month for railroads. For industrials all the supplementary pension plans are contributory. For railroads, 71 per cent have noncontributory plans, 14 per cent have contributory plans, and 14 per cent have both types of plan.

The replies to the question, "Does the plan

Table 1. Analysis of Returns by Type of Business or Industry.

Group	Number of Corporations Contacted	Number of Replies	Percentage Return	Number of Employees of Respondents
Industrials	39	26	67	2,026,735
Banks	16	11	69	56,252
Insurance companies	21	16	76	76,937
Utilities	16	9	56	99,721
Railroads	21	8	38	490,369
Total	113	70	62	2,750,014

TABLE 2. TYPES OF PENSION PLANS IN OPERATION.

Group	Noncontributory (Percentage)	Contributory (Percentage)	Both types of plan (Percentage)
Industrials	58	38	4
Banks	36	64	0
Insurance companies	44	56	0
Utilities	67	33	0
Railroads	0	100	0
Total	46	53	1

TABLE 3. DOES THE PLAN LINK BENEFITS WITH SOCIAL SECURITY?

Group	Yes (Percentage)	No (Percentage)	No answer (Percentage)
Industrials	73	23	4
Banks	55	45	0
Insurance companies	75	25	0
Utilities	67	33	0
Railroads	75	25	0
Total	70	27	3

link benefits with Social Security?" may be found in table 3. Seventy per cent of the respondents link pension benefits with Social Security or the Railroad Retirement Act. There is very little variation among the various corporation groups except for banks where only 55 per cent link benefits with Social Security.

The replies to the question, "At what age is retirement compulsory?" are given in table 4. The highest proportion of respondents set the compulsory retirement age at 65 years. Sixty per cent of the respondents require retirement at this age for men and 37 per cent for women. Industrials, insurance companies, and utilities show little variation in the proportion requir-

TABLE 4. AGE AT COMPULSORY AND OPTIONAL RETIREMENT.
Figures Given in Percentages.

		Age at Compulsory Retirement							Age at Optional Retirement					
Group		55	60	65	68	70	Not Compulsory	No Answer	50	55	60	65	After 25 Years	No Answer
Industrials	Men	0	4	58	15	8	12	4	0	27	38	23	4	8
	Women	8	27	27	15	8	12	4	12	38	15	23	4	8
Banks	Men	0	0	91	0	0	9	0	0	36	36	0	0	27
	Women	0	36	55	0	0	9	0	9	45	18	0	0	27
Insurance Companies	Men	0	0	69	0	31	0	0	0	13	44	19	0	25
	Women	0	19	69	0	13	0	0	6	19	38	13	0	25
Utilities	Men	0	0	67	0	22	11	0	0	22	22	22	0	33
	Women	0	56	22	0	11	11	0	11	44	11	0	0	33
Railroads	Men	0	0	0	0	25	75	0	0	0	25	63	0	13
	Women	0	0	0	0	25	75	0	0	0	38	50	0	13
Total	Men	0	1	60	6	16	16	1	0	21	36	23	1	19
	Women	3	27	37	6	10	16	1	9	31	23	17	1	19

ing compulsory retirement at age 65 for men, but 91 per cent of banks and none of the railroads require retirement at this age. Sixty-nine per cent of insurance companies and 55 per cent of banks set 65 as the compulsory retirement age for women as against 27 per cent of industrials and 22 per cent of utilities. The greatest range in compulsory retirement age is found in industrials. Only 1 per cent of the respondents set the compulsory retirement age before 65 for men but 27 per cent require retirement at 60 for women and 3 per cent at age 55. This sex difference is interesting. Women outlive men, yet are retired at a lower age. Of the companies having a compulsory retirement age 11 per cent permit some flexibility for male employees and 5 per cent for female employees. One company permits men to work beyond the compulsory retirement age on condition that the employee accept a less responsible job. Four per cent of the respondents require certain salaried employees to retire at a lower age than regular shop personnel.

Sixteen per cent of the respondents report no compulsory retirement age but this is not an accurate statement. Of the companies reporting no compulsory retirement age 55 per cent are railroads which, with few exceptions, actually operate under a compulsory retirement age. Under the Railroad Retirement Act there are no provisions for compulsory retirement. However, if an employee decides to remain after 65 or 70 years of age, depending upon the requirements of the company, he forfeits supplementary pension benefits for which he may be eligible and may also be subject to physical examination. Except for occasional exceptions all supervisory and executive personnel must retire at age 65 or 70.

The answers to the question, "At what age is retirement optional?" are also shown in table 4. For men, the highest proportion of respondents, 36 per cent, set the optional retirement age at 60, 23 per cent set it at 65, and 21 per cent set it at 55. For women, the highest proportion of the respondents, 31 per cent, set the optional retirement age at 55, 23 per cent set it at 60, 17 per cent set it at 65, and 9 per cent set it at 50. Again a sex difference is evident. In general women are permitted to retire at an earlier age than men.

The number of employees who were retired last year, for each of the corporation groups, is presented in table 5. Slightly more than 16,000 workers were retired, representing 0.6 per cent of the employees in the corporations surveyed. Railroads were highest with 1.4 per cent, followed by utilities with 1.0 per cent, insurance companies with 0.8 per cent, banks with 0.6 per cent, and industrials with 0.4 per cent. For railroads, the proportion of retired workers should be somewhat higher, since a number of the respondents gave figures only for employees retired on supplementary pension plans. For industrials, a number of respondents reported that pension plans covering 1.0 million workers were put into operation in 1950, some as recently as August and October. Therefore, a sharp increase in the number of employees retiring during the coming year may be expected.

TABLE 5. NUMBER OF EMPLOYEES RETIRED LAST YEAR.

Group	Number Retired	Percentage of Working Force
Industrials	7293	0.4
Banks	352	0.6
Insurance companies	598	0.8
Utilities	1041	1.0
Railroads	6794	1.4
Total	16078	0.6

The answers to the question, "Among your older employees do you find a fear of aging and being unable to keep up with younger workers?" may be found in table 6. Seventy-seven per cent of the respondents reported no evidence of a fear of aging. This is interesting in view of the fact that many workers planning for retirement report such a fear. Only 4 per cent of the respondents found a fear of aging among older workers. This may be an under-

estimation since 4 per cent of those who answered in the negative and 23 per cent of those who omitted the question added such phrases as "some," "very few," "not generally," "a few exceptional cases." Of those omitting the question 15 per cent stated they were unable to answer because pension plans had been instituted very recently.

The answer to the question, "Does your company give any special attention to older workers to help them overcome this fear and keep production high?" are also shown in table 6. Eleven per cent of the respondents give special attention to older workers as against 60 per cent who do not; 19 per cent of industrials and 18 per cent of banks give such special attention while none of the utilities or railroads do so. The proportion giving such special attention is probably an underestimation since one-third of those omitting the question mentioned "some," "very few," "we try to be considerate of their age and physical condition," "situation being studied." It is interesting that although 11 per cent of the respondents give such special attention to older workers only 4 per cent reported evidence of a fear of aging.

The answers to the question, "Have you found it necessary to make special provisions for older workers such as lighter jobs, less responsible jobs, reduced hours, etc.?" may also be found in table 6. Thirty per cent of the respondents make special provisions for older workers as against 41 per cent who do not. Industrials and utilities make special provisions to a greater extent than do banks, insurance companies, and railroads. The proportion of respondents making special provisions is probably higher, since 50 per cent of those omitting the question stated that this is done "occasionally," "on individual basis," "seldom," or "only where physical limitations exist." Twenty-four per cent of those who replied in the affirmative qualified their answers by stating that this applied to individual cases or was done occasionally. Again it is interesting to note that 30 per cent of the respondents make special provisions for older workers, although only 4 per cent find among their older employees a fear of aging and being unable to keep up with younger workers, and only 11 per cent give any special attention to older workers to help them overcome this fear and keep production high.

The answers to the question, "Do you find that workers become anxious and worried as they approach retirement age?" may also be found in table 6. Twenty per cent of the re-

TABLE 6. ATTITUDES TOWARDS AGE, RETIREMENT, AND PRE-RETIREMENT PROGRAMS. Figures Given in Percentages.

Group	Fear of Aging (See Question No. 10)			Help in Overcoming Fear (See Question No. 11)			Special Job Provisions (See Question No. 12)			Anxiety About Retirement (See Question No. 13)			Pre-Retirement Programs (See Question (No. 14)		
	Yes	No	No Answer	Yes	No	No Answer	Yes	No	No Answer	Yes	No	No Answer	Yes	No	No Answer
Industrials	8	73	19	19	50	31	50	35	15	23	54	23	46	50	4
Banks	0	91	9	18	55	27	18	36	45	18	45	36	55	45	0
Insurance Companies	6	81	13	6	69	25	13	69	19	6	56	38	25	69	6
Utilities	0	91	9	0	89	11	33	22	44	44	33	22	44	56	0
Railroads	0	50	50	0	50	50	13	38	50	13	13	75	0	88	13
Total Percentage	4	77	19	11	60	29	30	41	29	20	46	34	37	59	4

spondents found that workers become anxious and worried as they approach retirement as against 46 per cent who did not. Utilities showed the greatest recognition of this problem while insurance companies showed the least. Here again the proportion of respondents finding such anxiety should be somewhat higher since almost two-thirds of those omitting the question wrote in such phrases as "some exceptions," "generally no," "no evidence that this is a serious problem," "situation being studied." However, it does not appear that this is considered a serious problem by the respondents since 29 per cent of those who found that workers become anxious as they approach retirement qualified their replies by statements that only a small number of employees were affected in this way. Nevertheless the proportion finding anxiety and worry among workers approaching retirement is higher than the proportion who found a fear of aging among their older employees.

The answers to the question, "Does your company have any program, formal or otherwise, to help prepare employees for the problems they will have to face upon retirement?" are also shown in table 6. Of the respondents 37 per cent have some type of program as against 59 per cent who do not. Approximately half of industrials, banks, and utilities have a pre-retirement program as compared with one-fourth of insurance companies and none of utilities. Of the respondents who have no program of any kind, 2 per cent stated that help was available if any employee wanted it and an additional 15 per cent indicated that they were conscious of the need for such a program.

Twenty-six corporations reported that they have some type of program to help prepare employees for retirement. The areas covered and the extent of participation are shown in table 7. Some respondents give assistance in only one of these areas, others in all. As a group industrials give assistance in all areas, while banks, insurance companies and utilities do not. Of the respondents 69 per cent cover financial preparation and 62 per cent cover insurance and medical care; 35 per cent cover preventive medicine which includes physical problems of aging and steps to maintain health; 31 per cent cover outside activities and hobbies which may become revenue producing which in some cases may be related to the area of financial adjustments. Only 19 per cent cover housing and living arrangements and only 12 per cent attempt to prepare employees for adjustments in family relationships. The miscellaneous category includes: continued availability of company facilities for retired employees, contact with retired workers once a year through the department where they had formerly worked, or presentation of a book which discusses retirement problems.

The age groups to which the pre-retirement program is geared are also presented in table 7. The majority of respondents gear their programs to those at or near retirement; 38 per cent gear their programs to employees between 60 and 65 years and an additional 12 per cent to employees 7 to 10 years prior to retirement. Only 12 per cent of the respondents gear their programs to all age categories.

The media employed in reaching employees are also shown in table 7. Four per cent of the respondents reach their employees through the house organ only, and an additional 4 per cent through the house organ and group discussion. Almost half (46 per cent) reach their employees through individual counseling.

The answers to the following question may be found in table 8: "There has been a growing criticism of the use of age as the basis for retirement. Instead, it has been suggested that the decision to retire employees should be based only on the physical and mental ability to do the job. Do you agree with this suggestion?" Sixteen per cent agreed with this suggestion as against 57 per cent who did not. Banks (82 per cent) were most definite in their opposition to this suggestion. Twenty-seven per cent of the respondents did not answer the question, but slightly more than one-third of these listed reasons for or against the use of age as the basis for retirement. Of this group 14 per cent

TABLE 7. PRE-RETIREMENT PROGRAMS.
Figures Given in Percentages.
Areas Covered in Pre-Retirement Programs.

Area	Industrials	Banks	Insurance Companies	Utilities	Total
Financial	67	67	75	75	69
Insurance, medical care	42	83	50	100	62
Preventive medicine	58	0	0	50	35
Leisure and recreation	25	33	50	50	35
Outside activities and hobbies which may become revenue producing	42	33	0	25	31
Social contacts	25	0	25	50	23
Housing and living arrangements	25	17	0	0	19
Family adjustments	17	17	0	0	12
Miscellaneous	0	17	25	25	12
Age Groups to Which Pre-Retirement Program is Geared					
Age Groups					
All employees	17	0	25	0	12
20 years of service and over	17	0	0	0	8
50 years of age and over	0	0	0	25	4
7 to 10 years before retirement	8	0	0	50	12
60 to 65 years	50	50	25	0	38
No answer	8	50	50	25	27
Media Employed in Reaching Employees					
Medium					
House organ	8	0	0	0	4
House organ + group discussion	0	0	0	25	4
Individual counseling	50	50	25	50	46
House organ + individual counseling	17	17	25	25	19
House organ, group discussion, individual counseling	17	17	0	0	12
No answer	8	17	50	0	15

were in favor of the use of age as the basis for retirement, 43 per cent were against the proposal, and 43 per cent were noncommittal.

Respondents were asked to give the reasons for their answers to the previous question. There were 41 corporations who answered *No* or whose supplementary remarks would place them in this category even though they did not answer the question. The reasons given by these respondents who favored the use of age as the basis for retirement rather than the physical and mental ability to do the job are listed below. It is obvious from this list that there is considerable overlapping:

39 per cent claimed that retirement on the basis of age alone would prevent grievances which were bound to arise if any other basis were employed.

29 per cent stated that it would facilitate promotions and up-grading on the job.

29 per cent stated that retirement on the basis of physical and mental ability to do the job would be administratively impractical even though some considered that it was theoretically desirable.

24 per cent stated that there were no adequate objective criteria of physical and mental ability to do the job and that it left too much discretion to company officials.

TABLE 8. ANSWERS TO RETIREMENT QUESTION.

Figures Given in Percentages.

There has been a growing criticism of the use of age as the basis for retirement; instead it has been suggested that the decision to retire an employee should be based only on the physical and mental ability to do the job. Do you agree with this suggestion?

Group	Yes	No	No answer
Industrials	23	50	27
Banks	18	82	0
Insurance companies	13	50	37
Utilities	11	67	22
Railroads	0	50	50
Total	16	57	27

17 per cent believed that the use of age would facilitate the necessary planning for retirement on the part of employees. It would enable them to keep their self-respect by not having to explain why they had had to quit earlier than other workers.

12 per cent stated that it was one way of meeting the problem of the worker who loses his efficiency in his later working years. One respondent gave supporting evidence to this view by referring to a recent survey of 500 workers retired within a six month period in his particular plant. He indicated that a substantial percentage of the group studied was not earning the wages being paid and that most of these employees wanted to work after the normal retirement age. From this study the respondent concluded, "To do away with the automatic retirement age can only lead to inefficiency of operations and the detriment of employees who are attempting to work beyond their capacities."

10 per cent stated that a fixed retirement age would maintain vitality and lower average age within the organization.

10 per cent were miscellaneous replies. One respondent was opposed to a flexible retirement age because it would stifle initiative. Another stated that it would conflict with the main purpose of the pension plan. Still another argued in favor of age 65 as the time for retirement because Social Security has that age limit. The same respondent felt that rather than set up a flexible retirement age it would be better to set a higher age limit.

The reasons given by respondents in favor of a flexible retirement age varied considerably. Some believed that older employees are valuable because of their knowledge and experience, that calendar years do not indicate the value of a person, that an aging population dictates a policy of longer working years, that age as a criterion is no longer tenable because of the nation's defense needs and the social and economic implications of such a policy, and that the retirement age was advanced from 65 to 70 years for these reasons. One respondent reported that age was used as the basis for retirement because objective criteria of physical and mental ability were not available. Two respondents stated that they extend the age of retirement on the basis of health and past value to the company and give consideration to prevailing conditions and individual circumstances.

One respondent reported that a flexible retirement age was desirable but impractical. Two respondents indicated that a flexible policy existed toward all categories of employees with the exception of supervisory and executive personnel. One of these stated categorically that the ability to adjust to new procedures and conditions, and to make decisions rapidly and effectively was the first to deteriorate with approaching age. One respondent who did not commit himself by answering *Yes* or *No* to the previous question stated that his company insisted upon compulsory retirement only for top-level personnel whose appointment was dependent upon approval of the board of directors of the company.

DISCUSSION

At the present time it seems that most interest is centered around pensions—how much they should be, what formula should be used

in computing benefits, who should be eligible for them, how they should be financed, how they should be administered, etc. The big issue is a financial one.

The findings of this survey indicate that there is a growing interest on the part of business and industry in retirement problems and adjustment. Thirty-seven per cent of the respondents have some kind of pre-retirement program in operation. An additional 9 per cent indicate that they are conscious of the need for such a program. Some companies have initiated pilot studies as the basis for the development of a formal program. Others are beginning to explore the problems more fully in order to improve their present programs. Still others have done little or nothing up to the present time only because pension plans were established very recently in their organizations.

The most significant finding of this survey is that companies are facing the problems of preparation for retirement at different levels. The majority of respondents having programs in operation cover financial preparation and the related factor of insurance, hospitalization, and surgical benefits. Less attention is given to the physical aspects of aging and steps to maintain health, leisure time and recreation, and outside activities and hobbies which may become revenue-producing. The problems of psychologic preparation, security, maintenance of status in the community, housing and living arrangements, social contacts, and the relationship of the employee to his family receive little attention.

The effectiveness of the program or of the media employed in carrying out the program have not been covered in this survey, but some clues may be obtained from some of the unsolicited statements made in connection with the replies to the questionnaire.

Some companies seem to have developed well-integrated programs which attempt to prepare employees for the many adjustments that they may have to make at retirement. Others have minimal or token programs which do not begin to meet the problem. In some companies statements regarding benefits are sent to the employee periodically to enable him to estimate the size of his pension at retirement, but in most companies this information is given to the employee just a few months before retirement. In one company the extent of the pre-retirement program seems to be only in giving the employee a book on retirement problems. In another the running of a hobby club seems to comprise the entire program.

In some companies the responsibility for the preparation of the employee for retirement is left to department heads or supervisors who may be too busy to do effective counseling or whose ability to counsel effectively in this area may be questionable. Where supervisors and department heads are given such responsibility there is no evidence of any supervision or coordination of their activities. Some companies attempt to prepare employees for retirement through lectures or discussion groups. Unless programs employing media of this kind are worked out carefully they tend to be superficial. The method of approach and the material covered through these media may not make for communication between the group leader and the employee.

There is genuine merit in considering preparation for retirement from the time of hiring. At some point in the hiring procedure or in the process of introducing the worker to his job, a new employee is generally given some information about pensions and thrift and welfare plans along with other information that he should know about the company and its personnel practices. Often, however, the employee is unable to understand the significance of pension and thrift plans as they apply to himself unless special attention is given to this problem and continued at regular intervals throughout the worker's period of employment with the company. If we recognize that pension plans at their best will never approximate a regular wage, it is evident that planning with the employee becomes necessary to stimulate him to build toward financial security in his later years.

If the employee has not been able to acquire savings or if on retirement his expenditures will exceed his income, it is evident that he will need help in planning for full or part-time employment which, in turn, is dependent upon his health and the condition of the labor market. The employee may need assistance in planning for changes in housing and living arrangements, recreation, social contacts, and family relationships.

Even where income at retirement is sufficient to maintain the employee in a relative degree of comfort, he may need help in planning his leisure time activities at a time when the daily routine has been broken and when he will have large blocks of time on his hands. The stimulation and organization of pensioners' or annuitants' clubs and the provision of meeting facilities where pensioners can get together for visiting, recreation, and discussion of their common problems, the continued availability of company assistance in special cases, as well as the retention of pensioners' names on the mailing list for the house organ and other company literature should be very helpful in the maintenance of morale of pensioners by helping them bridge the gap between a lifetime of employment and retirement. A good, continuing retirement counseling program which will assist employees to live out their lives following retirement with satisfaction and with usefulness to themselves and society will make for improved employee relations and improved public relations.

Most of the corporations surveyed maintain the desirability and need of a fixed retirement age at or near 65 years, primarily because such a policy presents fewer administrative difficulties than a flexible retirement policy based on physical and mental ability to do the job. The validity of a fixed retirement age is questionable because of the severe losses to industry of workers who have the skill and ability to do an effective job and because of the economic implications in maintaining an increasing number of workers in idleness. During the last war many older workers were recalled from retirement and proved their worth as capable productive workers and a stable core of the labor force. In view of the present emergency which will necessitate the utilization of all available manpower to meet the requirements of national defense, industry will have to reconsider seriously its position regarding the question of a fixed retirement age and work out methods for the most effective utilization of older workers.

Summary

A survey of the 113 largest corporations in the United States was conducted by questionnaire to determine current practices in business and industry pertaining to retirement of employees. The questionnaire covered three broad areas: pension plans, psychologic reactions of older workers, and company programs to help prepare employees for retirement.

A 62 per cent return was received representing 70 corporations employing 2.75 million workers. The replies, which are suggestive of contemporary practice, indicate that while most interest is centered around pensions, there is a growing interest on the part of business and industry in retirement problems and adjustment. Almost half of the respondents have some kind of pre-retirement program in operation or are conscious of the need to institute such a program. These companies are meeting the problems of preparation for retirement at different levels and with varying degrees of effectiveness.

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The Housing Circumstances of the Aged in the United States, 1950

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DISCUSSIONS of the housing needs and problems of the aging in the United States have thus far suffered from the lack of a factual, overall picture of the existing housing circumstances of the aged. The absence of such information has made it virtually impossible to quantify the housing needs of the aged for the nation as a whole and to relate their needs to those of the rest of the population. The tendency has been to concentrate research in this field on welfare and medical aspects of housing, with too little attention given to the economic dimensions of the problem.

In the hope of remedying this situation, the Division of Housing Research of the Federal Housing and Home Finance Agency is presently analyzing special tabulations of data drawn from the Housing Census of 1950. The data under examination cover the income, gross rent, value of dwelling unit occupied, condition of housing, number of persons per room, number of persons in the household, and number of rooms occupied, by nonfarm families headed by persons in the following age groups: under 25, 25 to 29, 30 to 44, 45 to 54, 55 to 59, 60 to 64, 65 to 69, 70 to 74, and 75 and over. These heads of households have been further subdivided by sex and by tenure.

This survey, based upon a one-in-a-thousand sample of the American population, (See Appendix A for a technical note containing a measure of the sampling variability used in this study and explaining some of the terms employed) covers the housing circumstances only of those aged persons who are heads of households, not those who reside as dependents in families headed by younger persons. For purposes of this paper, let us simply define the aged as those over age 65. The total number of persons over 65 living in urban or rural nonfarm housing in 1950 was 10,570,000, of whom 5,840,000 were females and 4,730,000 were males. We have estimated that at least 80 per cent of all persons over age 65 maintained independent households.

Tenure.—Persons over 65 in America are home owners to a much greater extent than are Americans in general. Of all nonfarm units in the United States, 53 per cent were owner-occupied in 1950; of all household units headed by persons over 65, 68.2 per cent were owner-occupied. Of male heads over 65, 69.2 per cent were home owners, and 63.8 per cent of female heads over 65 owned their own homes.

Value of houses owned.—The data cover the value only of one-dwelling unit structures. Persons over 65 own less valuable structures than does the American population generally. For the nation as a whole, the median estimated value of nonfarm one-dwelling unit structures was $7,400. The median estimated value of such structures owned by persons over 65, however, was only $6,000.

Rent.—The data cover the gross monthly rent of urban and rural nonfarm dwelling units. Persons over 65 were found to pay lower rents than the rest of the population. For all nonfarm renter-occupied dwelling, 23.9 per cent paid less than $30.00 a month gross rent; of persons over 65, 39.9 per cent paid rents less than $30.00 per month. At the upper end of the scale, 19.8 per cent of all renters paid over $60.00 monthly rent, whereas only 14 per cent of persons over 65 paid $60.00 rent or more.

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Number of persons per dwelling unit.—The number of persons in each dwelling unit occupied by households headed by persons over 65 was smaller than for the general population. While 25.3 per cent of persons over 65 constituted one-person households, only 9.8 per cent of the general population lived alone. In 1950, 68.6 per cent of households headed by persons over 65 consisted of 2 persons or less; in the general population, the corresponding figure was 38.4 per cent.

In absolute numbers, we have in the United States 1,405,000 persons (985,000 females and 420,000 males) over 65 who are living in one-person nonfarm households and 2,402,000 persons over 65 who head two-person nonfarm households.

Number of rooms in dwelling unit.—Households headed by persons over age 65 tend to have larger dwelling units than those occupied by the general population. Of all nonfarm households in the nation, 51.5 per cent occupied 5 rooms or more, while of nonfarm households headed by persons aged 65 or older, 58.1 per cent had 5 rooms or more. The equivalent figures for dwelling units of 6 rooms or larger were 29.6 per cent for the general nonfarm population and 38.6 per cent for households headed by persons 65 or older; and for 8 rooms or more, 6.3 per cent for the general nonfarm population and 10.8 per cent for households headed by persons over 65.

Overcrowding.—Since households headed by persons over 65 tend to have fewer persons and to have more space than other households, the amount of overcrowding among households headed by older persons was conspicuously less than for the population as a whole. If the commonly used standard of more than 1.5 persons per room is used to denote overcrowding, only 2.2 per cent of households headed by persons over 65 are overcrowded. This contrasts with a figure of 5.5 per cent for the general population. At the other end of the scale, we find that 82.2 per cent of households headed by persons over 65 had a ratio of 0.75 or fewer persons per room, whereas for the general population only 60.5 per cent had ratios of 0.75 or fewer persons per room.

Condition of housing.—Housing conditions of persons over 65 seem from our study to have been somewhat worse than for the general population. Of all nonfarm households in the United States, 7 per cent occupied dilapidated housing, while the corresponding figure for households headed by persons 65 and over was 8.4 per cent.

However, housing conditions of the aged were worse than only the number of dilapidated units would indicate. The Housing Census of 1950 employed three indices of housing quality: availability of a private, indoor flush toilet, of private bathing facilities, and of hot running water. Of all dwelling units occupied by nonfarm households headed by persons over 65, only 63.9 per cent had a private toilet and bath and hot running water and were not dilapidated. The corresponding figure for all nonfarm households in the United States was 70.4 per cent.

In absolute numbers, heads of households over 65 occupied about 675,000 dilapidated dwelling units, and about 1,200,000 units lacked a private flush toilet or bath.

The most important causal factor for the relatively poorer housing of the aged seems from our study to be the low income of persons over 65 as compared with that of the rest of the population. In 1949, 46.4 per cent of primary families headed by persons over 65 and of primary individuals over 65 had incomes of less than $1,000 per year. The equivalent figure for households headed by persons younger than 65 was only 11.5 per cent. Of those over 65, 64.4 per cent had incomes less than $2,000 per year. Only 24.6 per cent of those younger than 65 earned less than $2,000 per year.

The second principal factor accounting for the poorer housing of the aged is that old people frequently live in old houses, which are often deficient in plumbing facilities; further, these old houses are frequently situated in neighborhoods which, in a period of decentralization of urban areas such as almost all

of our cities have been experiencing, tend to become slums, hastening the blight of the dwellings of the aged.

Summary

Over 80 per cent of people over age 65 in urban and rural nonfarm areas of the United States maintain independent households. Generally speaking, their housing circumstances are worse than are those of the rest of the population. The aged tend to occupy relatively more very low rent dwelling units and low value structures, and their housing is relatively more dilapidated and deficient in plumbing facilities. However, as regards overcrowding, persons over 65 are better off than the rest of the American population. The housing characteristics of the aged stem principally from the following circumstances: the aged receive less income, have smaller families, and occupy older dwellings in older neighborhoods than do other groups in the population.

Appendix A

Technical Note for Tabulation of Characteristics of Dwelling Units by Age of Head: April, 1950

(Prepared by the Bureau of the Census)

Definitions and Explanations

Definitions of some of the terms used in the tabulation are given below. For definitions of other terms, such as farm and nonfarm residence, dwelling unit, condition and plumbing facilities, refer to the report, *Housing Characteristics of the United States: April 1, 1950,* Bureau of the Census, Series HC-5, No. 1.

Urban and rural residence.—According to a new definition of the Bureau of the Census[1], the urban population comprises all persons living in (a) places of 2,500 inhabitants or more incorporated as cities, boroughs, and villages; (b) the densely settled suburban area, or urban fringe, incorporated or unincorporated, around cities of 50,000 or more; (c) unincorporated places of 2,500 inhabitants or more outside of any urban fringe; and (d) places of 2,500 inhabitants or more incorporated as towns except in New England, New York, and Wisconsin, where "towns" are simply minor civil divisions of counties. The remaining population is classified as rural.

According to the old definition, the urban population comprised all persons living in incorporated places of 2,500 inhabitants or more and in areas (usually minor civil divisions) classified as urban under special rules relating to population size and density.

Farm and nonfarm residence.—The rural population is subdivided into the rural-farm population, which comprises all rural residents living on farms, and the rural-nonfarm population, which comprises the remaining rural population. However, the method of determining farm and nonfarm residence in the 1950 Census differs somewhat from that used in earlier censuses. In the 1950 Census, persons on "farms" who were paying cash rent for their house and yard only were classified as nonfarm; furthermore, persons in institutions, summer camps, "motels," and tourist camps were classified as nonfarm.

Tenure.—A dwelling unit is classified as owner-occupied if it was owned wholly or in part by the head of the household or by some related member of his family living in the dwelling unit. All other occupied units are classified as renter-occupied whether or not cash rent was paid for the living quarters. Rent free units and living accommodations received in payment for services performed are thus included with the renter-occupied units.

Income.—Income is the total amount of money income received in 1949 by all members of a primary family, or by a primary individual, from the following sources: money wages or salaries; net income (gross receipts minus expenses) from the operation of a farm, business, or profession; net income (or loss) from rents; interest and dividends; pensions; veterans' payments, armed forces allotments for dependents, and other governmental payments or assistance; receipts from roomers or boarders; royalties; and other income such as alimony, contributions for

[1] As the result of changes in the urban definition, the figure for the urban population in 1950 is about 8,000,000 larger than it would have been under the definition used in the 1940 Census and in the Census Bureau's Current Population Surveys prior to 1950. Furthermore, because of changes in the farm definition and other reasons noted below, the figure for the rural-farm population in April, 1950, is about 4,700,000 smaller than the estimate for the total farm population in April, 1949, published in Series Census-BAE, No. 14. The April, 1949, figure was based on the Current Population Survey and reflects the old (1940) definition. This change in definition accounts for perhaps 2,100,000 of the total difference. Furthermore, in obtaining the figure for April, 1949, the urban-farm population was included and the population in quasi-households was distributed between urban and rural areas in the same proportion as the population in households; these changes together with others made in the 1950 Census procedures, as compared with the earlier Current Population Survey procedures regarding the farm population, account for approximately another million of the difference. The remaining difference of roughly 1,500,000 to 2,000,000 between the figures for April, 1949 and 1950, should be interpreted with considerable caution because both figures are based on samples; however, the figures indicate that there was a decline in rural-farm population between the two dates.

support from persons who are not members of the household, periodic income from estates and trust funds, and periodic receipts from insurance policies or annuities.

Primary families and primary individuals.—A primary family consists of the head and all persons related to him by blood, marriage, or adoption, and residing with him. If no persons related to the head are living with him, the head is considered a primary individual. Each occupied dwelling unit, therefore, contains either a primary family or a primary individual.

Gross rent.—The gross rent is the contract monthly rent plus the reported average monthly cost paid by the renter for water, electricity, gas, and other fuels. (Contract monthly rent is the rent contracted for by renters of nonfarm dwelling units at the time of enumeration. The rent is the amount contracted for regardless of whether it includes furniture, utilities, or personal services.) If furniture is included in the contract rent, the reported estimated rent of a dwelling unit without furniture is used in the computation instead of contract rent.

Value.—Value data are for nonfarm owner-occupied dwelling units. Value is shown only if the unit is in a one-dwelling-unit structure without business and if it is the only dwelling unit included in the property. The value represents the amount for which the owner estimates that the property, including such land as belongs with it, would sell under ordinary conditions and not at a forced sale.

Source and Reliability of the Data

Source of data—The figures are based on a preliminary sample of about 38,000 dwelling units selected from those enumerated in the 1950 Census of Housing. These dwelling units are located in about 14,000 Census enumeration districts systematically selected from all enumeration districts throughout the Nation.

Reliability of data.—Because the figures are based on sample data, they are subject to sampling variability. Table 1 presents the approximate sampling variability of estimates of selected sizes. The chances are about 19 out of 20 that the difference due to sampling variability between an estimate and the figure which would be available if a complete tabulation of the 1950 Census were made is less than the sampling variability indicated in table 1.

TABLE 1. APPROXIMATE SAMPLING VARIABILITY OF ESTIMATES OF SELECTED SIZES.

Size of Estimate	Sampling Variability	Size of Estimate	Sampling Variability
10,000	9,000	5,000,000	202,000
50,000	20,000	10,000,000	285,000
100,000	29,000	15,000,000	348,000
300,000	50,000	20,000,000	402,000
500,000	64,000	30,000,000	490,000
1,000,000	90,000	40,000,000	564,000
3,500,000	169,000		

In addition to the absolute figures, the tabulation may be converted to percentage distributions. In general, the reliability of an estimated percentage depends upon both the size of the percentage and the size of the total on which it is based. Table 2 presents the approximate sampling variability of estimated percentages based on totals of selected sizes.

TABLE 2. APPROXIMATE SAMPLING VARIABILITY OF ESTIMATED PERCENTAGES BASED ON TOTALS OF SELECTED SIZES.

If the estimated percentage is:	And if the size of the base is:					
	500,000	1,000,000	5,000,000	15,000,000	25,000,000	42,520,000
	Then the chances are about 19 out of 20 that the difference due to sampling variability between the estimated percentage and the percentage which would be available if a complete tabulation of the 1950 Census were made is less than:					
2 or 98	1.8	1.3	0.6	0.3	0.3	0.2
5 or 95	2.8	2.0	0.9	0.5	0.4	0.3
10 or 90	3.8	2.7	1.2	0.7	0.5	0.4
25 or 75	5.5	3.9	1.8	1.0	0.8	0.6
50	6.4	4.5	2.0	1.2	0.9	0.7

Although the figures are based on data transcribed from the 1950 Census, there may be differences between the data in the present tabulation and the data to be published in the final 1950 Census reports, apart from differences caused by the sampling variability. The main reason for such differences is that the preliminary data do not include all of the refinements that result from the careful examination of the schedules and tables to which the census data will be subject prior to the publication of the final report.

In addition to sampling variability and limitations of the types mentioned above, the estimates are subject to biases due to errors of response and to nonreporting. The possible effect of such biases is not included in the measures of reliability; data obtained from a complete count of all dwelling units are also subject to these biases.

From the Division of Housing Research, Housing and Home Finance Agency, Washington, D. C. The Housing and Home Finance Agency is the overall Federal agency in the housing field. It was established by the President's Reorganization Plan No. 3, July 27, 1947.

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Labor Force Trends in the United States

EWAN CLAGUE

THE broad patterns of labor force trends in the United States as they affect the economic status of the mature and aging worker have been well documented in recent years. They parallel in striking fashion the trends in the industrial nations of Western Europe. We have experienced, on the one hand, a strikingly rapid growth in our aged population, both numerically and in relation to the total population. Opportunities for gainful activity, on the other hand, have not kept pace with this growth. This disparity lies at the core of the economic problems of the aged and our aging population.

These broad trends can be measured in two ways: First, in terms of the aggregate numbers of older persons in the labor force in relation to population changes. Second, and perhaps more vividly, in terms of the combined impact of mortality and labor force trends on the work-life expectancy of the individual worker.

At the beginning of this century there were in the United States about 3 million persons aged 65 and over, or 4 per cent of the population. The age span 45 to 64 years, during which many persons first experience an economic problem arising from age, included nearly 10.5 million persons, or about 14 per cent of the population. At present, we have nearly 12 million persons in the age group 65 years and over, and 32 million between 45 and 64 years of age. These groups, taken together, now account for nearly 30 per cent of the total population.

The increase in older persons as a proportion of the total labor force also has been pronounced, but more moderate (table 1). In 1900, slightly less than 1 out of 4 of all workers in the United States was 45 years and over. At present, the ratio is about 1 in 3. These over-all ratios conceal, however, divergent movements in labor force participation among mature women and men in different age groups (table 2). The steady up-trend in employment of women outside of the home is reflected in their rates of labor force participation over the past five decades, which have doubled at ages 45 and over. Nearly all of this gain has occurred among married women in the age groups 45 to 64. Labor force activity of women above this age has shown very little net change, and less than 10 per cent of all women aged 65 and over are at present gainfully employed.

In contrast, there has been a sharp decline in labor force activity among older men, which is most significant for men over 65. The proportion of these men in the labor force has declined from 63 per cent in 1900 to slightly under 42 per cent in 1950, according to Decennial Census data. There has also been a slight down-trend in the 55 to 64 age group.

The impact of these broad trends on the life pattern of the individual worker is illustrated by the estimates of work-life expectancy developed recently in the Bureau of Labor Statistics. These estimates are derived from an application of the techniques used in construction of the conventional life table to the measurement of the length of working life (4). In 1900, when a white male aged 40 could expect to live, on the average, to age 68, he could expect to remain in the labor force for an average of 24.5 years, or to age 64.5 (table 3). He could expect, therefore, to live slightly over three years after the end of his working life. By 1940, the life expectancy of the 40 year old white man had increased to age 70; however, his working life expectancy had declined slightly. As a result, the span of retirement had nearly doubled.

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TABLE 1. LABOR FORCE BY AGE AND SEX, 1900, 1950, AND PROJECTED 1975

Age and Sex		1900[1]		1950		Projected 1975	
		Number (in Thousands)	Percentage	Number (in Thousands)	Percentage	Number (in Thousands)	Percentage
Total,	14 years and over	27,640	100.0	63,513	100.0	92,000	100.0
Males,	14 years and over	22,641	81.9	45,429	71.5	61,100	66.4
	14–44	16,696	60.4	29,078	45.8	39,200	42.6
	45 years and over	5,945	21.5	16,352	25.7	21,800	23.7
	45–54	3,172	11.5	8,147	12.8	11,100	12.1
	55–64	1,786	6.5	5,746	9.0	7,600	8.3
	65 years and over	987	3.6	2,459	3.9	3,100	3.4
Females,	14 years and over	4,999	18.1	18,084	28.5	31,000	33.7
	14–44	4,200	15.2	12,396	19.5	19,200	20.9
	45 years and over	799	2.9	5,690	9.0	11,700	12.7
	45–54	427	1.5	3,246	5.1	6,400	7.0
	55–64	245	.9	1,868	2.9	3,800	4.1
	65 years and over	127	.5	576	.9	1,500	1.6

Detail does not necessarily add to group totals due to rounding. Figures for 1900 adjusted to include persons of unknown age. Data refer to April, except for 1900 which refer to June.

[1] Based on Decennial Census data and not completely comparable with data for 1950 and 1975, which are comparable with current labor force estimates.

Source: 1900, John D. Durand, *Labor Force in the United States, 1890-1960;* 1950, U. S. Bureau of the Census, Monthly Report on the Labor Force; 1975, U. S. Bureau of Labor Statistics.

TABLE 2. PERCENTAGE OF PERSONS AGED 45 YEARS AND OVER IN THE LABOR FORCE, BY AGE AND SEX, 1900–1975.

Age and Sex		Comparable with 1940 Census Data				Comparable with Current Labor Force Estimates			
		1900	1920	1940	1950[1]	1940	1945	1950	Projected 1975
Males,	45 years and over	84.3	83.2	77.7	75.2	78.8	82.6	78.5	73.1
	45–54	92.8	93.5	92.7	91.7	93.7	97.4	94.6	94.6
	55–64	86.1	86.3	84.6	82.9	85.7	88.4	85.1	82.3
	65 years and over	63.2	55.6	42.2	41.6	43.4	49.9	45.0	35.3
Females,	45 years and over	12.3	14.3	16.3	22.2	17.7	26.3	26.2	32.8
	45–54	14.2	17.9	22.4	33.0	24.2	36.4	36.9	52.2
	55–64	12.6	14.3	16.6	22.8	17.8	27.4	27.3	35.4
	65 years and over	8.3	7.3	6.0	7.6	6.7	9.4	9.5	11.8

Data refer to April, except 1900 (June) and 1920 (January).

[1] Preliminary Census data adjusted to include armed forces overseas.

Source: Census data, 1900–1940: John D. Durand, *Labor Force in the United States, 1890–1960;* 1950: U. S. Bureau of the Census. Current labor force estimates, 1940–1950: U. S. Bureau of the Census, Monthly Report on the Labor Force; 1975: U. S. Bureau of Labor Statistics.

TABLE 3. AVERAGE NUMBER OF REMAINING YEARS OF LIFE, IN LABOR FORCE AND IN RETIREMENT; WHITE MALES; 1900, 1940; TOTAL MALES, 1940, 1947, 1975.

Year	Average Number of Years of Life Remaining		
	Total	In Labor Force [1]	In Retirement
	At Age 20		
White Males: 1900 [1]	42.2	39.4	2.8
1940	47.7	42.0	5.7
Total Males: 1940	46.8	41.3	5.5
1947	48.0	42.8	5.2
1975 (A) [2]	52.7	42.8	9.9
1975 (B) [2]	52.7	45.9	6.8
	At Age 40		
White Males: 1900 [1]	27.7	24.5	3.2
1940	30.1	24.2	5.9
Total Males: 1940	29.6	23.8	5.8
1947	30.2	24.8	5.4
1975 (A) [2]	33.9	24.5	9.4
1975 (B) [2]	33.9	27.2	6.7
	At Age 60		
White Males: 1900 [1]	14.3	11.5	2.8
1940	15.1	9.2	5.9
Total Males: 1940	15.1	9.2	5.9
1947	15.3	9.7	5.6
1975 (A) [2]	16.8	7.9	8.9
1975 (B) [2]	16.8	10.5	6.3

[1] Mortality data based on records of 11 original death registration States.

[2] A: Assumes continued decline in labor force participation rates for men, 55 years and over, based on 1920–40 trends. B: Assumes labor force participation rates at 1947 levels.

Source: U. S. Bureau of Labor Statistics, Bulletin 1001, *Tables of Working Life: Length of Working Life for Men.*

If this lengthening of the retirement period resulted from a real preference for leisure in old age instead of continued gainful activity and from an increasing financial ability to retire, we could count this as a very salutary development. However, the information available to us on this subject points to the opposite conclusion. It appears that earlier retirement has been forced upon older workers as a result of a lack of suitable employment opportunity. Our experience during World War II, for example, provides ample evidence that many older persons flock back into the labor market when their services are in demand. It is significant, too, that large numbers of workers eligible for Old Age and Survivors Insurance or for other pension benefits have continued in employment in recent years, rather than retiring on their pension. Of 3 million living workers, aged 65 and over, who were eligible, as of January 1, 1951, for old age insurance benefits under the Social Security Act, 1.25 million—or about two-fifths—were not receiving such benefits. All but a small percentage of the latter group consisted of workers who either had continued in covered employment or had returned to work after age 65.

The social and economic factors underlying these trends in population and the structure of employment in the United States are present in Western industrial nations generally. In the United States, however, these developments have tended to occur more rapidly than elsewhere, reflecting the more intense pace of industrialization in this country.

The most important of these changes has been the decline in importance of agriculture, which, in contrast to urban industry, often provides a flexible work outlet for the aging worker. In 1950, for example, 64 per cent of men aged 65 and over residing in farm areas were in the labor force, as against 40 per cent of those in the same age group in urban areas. Employment on farms declined from 11 million in 1900, to 7.5 million in 1950. This trend, moreover, has shown no evidence of abatement in recent years. Between 1945 and 1950, for example, farm employment in the United States declined by an average of 200,000 annually, according to Census Bureau estimates.

The transformation of urban industry from a predominantly small-scale type of enterprise to the modern large-scale business unit also has resulted in curtailed employment opportunities for the aging worker. While aging, as we know, is a gradual process, modern business, with its rapid work schedules, fixed job standards and emphasis on speed, allows little leeway for the gradual adjustment of the worker to his changing capacities. Moreover, the progressive replacement of skilled handwork by mass production machinery in many industries has eliminated or greatly reduced the advantages formerly enjoyed by the mature craftsman. In the United States, particularly, this problem has been greatly intensified by the rapid pace of technologic change which has rendered many skills obsolete and has placed a premium upon the adaptability and flexibility of youth. Another occupational trend which has operated to the disadvantage of the older man or woman is the rapid expansion of the clerical and sales group of occupations, where employers characteristically prefer younger people. Thus, the older worker today is typically faced with the necessity of making a complete break from his job. This occurs most often at some arbitrary chronologic age, such as 65.

Although the basic employment difficulties of the older worker have transcended the ups and downs of the business cycle, these problems were greatly intensified during the world-wide depression of the 1930's, which was particularly severe in the United States. Older workers, once laid off, found it increasingly difficult to find reemployment. As the decade wore on, many of these older men and women came to be regarded, and even to regard themselves as "too old to work" and withdrew from any active efforts to seek work. Thus, by the time of the 1940 Census, the heavy impact of the depression decade upon the older worker was evident in two ways: reduction in labor force participation for those 65 years and over, and the high rates of unemployment among those workers between 45 and 64.

In April, 1940, 14 per cent of workers in the age group 45 to 64 years were reported as unemployed, compared to an unemployment rate of 12 per cent for younger adult workers aged 25 to 44. Moreover, the duration of unemployment tended to be much longer at the older ages. Of all experienced wage and salary workers in the 45 to 64 age group, 54 per cent had been unemployed for six months or longer, more than three times the ratio shown for those between 25 and 44 years of age. In the case of men workers 65 years and older, the curtailment of work opportunities during the depression was evidenced primarily in a sharp reduction in their rates of labor force participation, from 54 per cent in 1930 to 42 per cent in 1940.

The economic dilemma of the aged worker in the United States was intensified by the fact that this country had lagged far behind Western Europe in the development of social insurance programs. It was not until 1935 that an over-all Federal Social Security program was enacted in the United States, and not until 1940 that monthly old age insurance payments, in contrast to assistance grants, actually were initiated. Coverage under this program, moreover, was incomplete and the benefits were on a comparatively moderate scale, even in terms of prewar price levels. The Social Security program had the dual objective of providing a modicum of income to aged persons, and, at the same time, of encouraging workers to withdraw from employment in order to make room for younger people. In this latter aspect, therefore, it was shaped particularly by the depression philosophy of a shortage of jobs and an over-abundance of workers.

With the United States entry into World War II, there was a dramatic change in the employment situation of the older worker. The labor market was transformed from one of labor surplus to one of labor shortage. Unemployment dropped sharply from an average of 8 million in 1940 to 3 million in 1942 and to less than 1 million in 1944. As the labor market tightened and as the armed forces drew millions of younger men out of civilian employment, employers relaxed their hiring standards and increasingly turned to reserve groups in the population, including housewives,

youths, and older persons. By the end of the war, the total labor force, including the armed forces, had increased by 11 million, or by 8 million more than the normal growth expected on the basis of population increase and prewar labor force trends. Of this total of "extra" workers, about 2.5 million were men and women past age 45.

Even under conditions of wartime stress, however, there were indications that many employers were reluctant to hire older people, particularly those over age 65, except when all other sources of manpower had been depleted. In the early phases of mobilization, unemployment among older workers declined much more slowly than among younger men and women. Between April, 1940, and April, 1942, unemployment was reduced by less than 50 per cent among workers 45 to 64 and by 30 per cent among workers 65 and over, as against a reduction of 70 per cent in unemployment among workers under 45. Similarly, the rate at which older men were drawn into the labor force lagged behind that for women and young people. Since the end of World War II, moreover, there has been a resumption of the long-term down-trend in work activity among older men. By 1950, worker rates for men in age groups 55 and over were at or near 1940 levels, despite the sharp disparity in the general employment situation between the two periods.

Since the outbreak of Korean hostilities and the inception of a large-scale defense production program, the United States has experienced a marked increase in the demand for labor and an over-all tightening of the labor market. Unemployment has declined sharply, from 3.4 million in June, 1950 to under 2 million in the summer of 1951, a postwar low for this time of year. The current unemployment total, moreover, consists largely of persons who have been seeking work for comparatively short periods. In July of 1951 almost three-quarters of the unemployed had been seeking work for less than seven weeks.

Nonagricultural employment has expanded by almost 2 million over this past year, while the armed forces have more than doubled. Moreover, the full impact of the defense production program on our manpower resources still lies largely in the future. By the end of 1952, we have estimated that the total number of persons required in defense activities—including the armed forces, munitions production, and activities indirectly contributing to the defense production program—will total 12 million, or 1 out of 6 in the American labor force (3). Meeting this manpower goal will require the net addition of 2 million workers to defense activities during the second half of this year and an additional 2.5 million workers during 1952. Many of these workers will become available automatically as civilian production is curtailed in certain sectors of the economy. However, we have estimated that it will be necessary to draw into the labor force by the end of 1952 between 1 and 1.5 million more workers than would be available on the basis of recent trends.

Although a considerable expansion of the labor force has already been achieved, most of the task of recruitment of "extra" workers still lies ahead. The task, in some respects, is relatively more difficult than during our all-out mobilization in World War II. Among younger adult women, the record birth and marriage rates of recent years have reduced the potential for labor force expansion. As to the youth—another important reserve group—social policy as well as the longer-range interests of the defense mobilization program require that we encourage youngsters of high school and even college age to continue their schooling, rather than to enter prematurely into employment or the armed forces. Thus, older men and women represent at present one of our major potentials for labor force expansion. The older worker, moreover, can make a contribution far greater than indicated by his numerical importance, since many of the older men possess skills already in short supply.

From this standpoint, it is somewhat discouraging that the statistical evidence to date does not indicate as yet any significant reversal in the previous decline in labor force

activity among men 65 years and over. In fact, the rates of labor force participation for this group are still below the level of recent postwar years, although there is some evidence of leveling off or possible reversal of the downtrend in the past few months. There is evidence, moreover, that unemployed older workers are being absorbed into employment at a slower rate than job seekers in the younger age groups. Despite the sharp decline in unemployment during the past year, to the lowest over-all level since the end of World War II, the unemployment rate for men aged 45 and over in the second quarter of 1951 was still significantly higher than for younger adult males (table 4). It was, in fact, about the same as in the corresponding quarter of 1948, in contrast to the markedly reduced rates for younger adult males.

TABLE 4. UNEMPLOYMENT RATES, BY AGE AND SEX, SECOND QUARTER 1948, 1950, AND 1951.

Age and Sex		1948	1950	1951
Total, 14 years and over		3.3	5.2	2.8
Males,	14 years and over	3.2	5.2	2.4
	14–24	7.4	9.8	5.2
	25–44	2.2	3.9	1.5
	45 years and over	2.3	4.6	2.3
	45–54	2.0	4.0	2.0
	55–64	2.5	5.4	2.4
	65 years and over	2.7	4.5	3.1
Females,	14 years and over	3.7	5.4	3.8
	14–24	6.3	8.7	5.4
	25–44	2.9	4.6	3.5
	45 years and over	2.4	3.8	3.0
	45–54	2.3	4.1	3.1
	55–64	2.9	3.6	2.8
	65 years and over	1.1	3.0	2.5

Source: U. S. Bureau of the Census, Monthly Report on the Labor Force.

Turning to the longer-range perspective of a generation or more in the future, we must recognize that the evidence to date offers no facile hopes for reversing or even halting the long-term historical trend. Even if we succeed, under the pressure of a program of intensive defense preparations, in delaying the retirement of some workers or in drawing others into gainful activity from retirement, our recent experience does not warrant any optimistic conclusion as to our ability to retain these gains under more normal conditions.

Projections of labor force trends recently prepared in the Bureau of Labor Statistics have, therefore, been based upon an assumption that the long-term decline in labor force participation of men 65 years and over will continue in the next generation unless some positive measures are taken to arrest or slow down the decline (5). These projections indicate that the United States labor force will expand from 63.5 million in April, 1950, to a level of between 86 and 92 million in 1975. Although we have projected a continued uptrend for women workers 45 years and over, on the basis of long-term trends and recent postwar experience, the projections indicate a further sizeable decline in the proportion of men 65 years and over in the labor force, from 45.0 per cent in 1950 to 35 per cent in 1975. Because of the continuing rapid growth of the aged population, however, the number of men 65 years and over actually in the labor force would still be about .5 million higher than in 1950. Moreover, in the age group 45 to 64 years of age, where little net change in labor force participation is expected, the labor force growth will be even more pronounced.

From the standpoint of the individual worker, the trends toward an aging population and a declining rate of labor force participation in the upper age brackets mean a further widening of the gap between his total life span and his span of working life. Under 1975 conditions, assuming a continued favorable trend in mortality, the average 40 year old man could expect to live almost to age 74 (1). However, on the basis of prewar trends in labor force participation, he could anticipate nearly nine and a half years in retirement, as compared to slightly less than six years in 1940. Even if we assume the more favorable 1947 rates of labor force participation for 1975, the average period of retirement would

still be increased significantly, to nearly seven years (4).

Needless to say, projections based on extrapolations of past trends may—and, in this case I hope will—differ sharply from actual developments. Not all of the social and economic forces which are operating or which may operate in the future will be unfavorable in this respect. As against the rapid expansion of mass production manufacturing industries during the past few decades, this Nation may witness an accelerated growth in the tertiary industries, particularly in the professional and service fields. In these areas, the employment handicaps of the older workers are often at a minimum and, in many cases, maturity is a positive asset.

The rapid extension of secondary and higher education also offers some real hope for increasing the mobility and adaptability of the aging worker. The average person 65 years and over in the United States population in 1940, who grew up in a period when educational opportunities were generally limited, had an average period of schooling of only eight years, that is, a grammar school education (2). The young men of this generation, who will be approaching retirement age in 1975, are typically high school graduates, with a growing proportion going on to college. The close relationship between educational attainment and opportunity for continued gainful employment in mature years is indicated by data available from the 1940 Census (table 5). Among men 55 to 64 years of age, about 89 per cent of the college graduates were in the labor force, as compared to 85 per cent for those who had completed seven to eight years of school, and 82 per cent for those whose education had ceased before the fifth grade. These figures do not mean that an increasing level of education will of itself guarantee an extension of working life, but certainly the opportunities will be greater.

Another promising factor in the long-range outlook is the constant improvement in the physical vigor of our population. It is reasonable to assume that advances in medical science and a higher level of hygiene and nutrition will mean that the generation of persons reaching old age a few decades hence will be healthier and more capable of productive work than the present generation of older people.

TABLE 5. PERCENTAGE OF NATIVE WHITE POPULATION AGED 45–64 IN THE LABOR FORCE, BY EDUCATIONAL ATTAINMENT, 1940.

Years of School Completed	Males		Females	
	45–54 Years	55–64 Years	45–54 Years	55–64 Years
Total [1]	92.2	84.5	21.4	16.5
No school years completed	79.5	72.2	12.7	10.1
Grade schools:				
1 to 4 years	89.0	81.6	14.4	11.7
5 and 6 years	90.9	83.7	15.2	12.0
7 and 8 years	93.0	85.3	18.3	14.5
High school:				
1 to 3 years	94.0	86.9	21.8	18.1
4 years	94.0	86.5	26.2	20.1
College:				
1 to 3 years	94.2	87.0	31.3	26.6
4 years or more	95.4	89.3	46.4	39.1

[1] Includes persons whose educational attainment was not reported.

Source: U. S. Bureau of the Census, *1940 Census of Population, Educational Attainment by Economic Characteristics and Marital Status.*

These favorable trends in and of themselves offer, of course, little prospect for a solution to the economic problems of an aging population. Given, however, an expanding and healthy economy, the goal of maintaining or even widening the scope of employment opportunities for older people is a feasible one, provided that we develop and apply positive measures for extending the period of working life. Through scientific study of the psychologic and physical changes accompanying the process of aging and through realistic analysis of job requirements in relation to these changes, we can develop a systematic body of knowledge regarding the employment potential of older persons. Comparatively little information of this kind is available today, but once it were

obtained on a more comprehensive basis, we would be in a position to initiate a coordinated, sustained program for overcoming unnecessary barriers to the employment of older persons, and for assisting older workers in adjusting themselves to changing industrial conditions. Although it is inevitably a lengthy and difficult process to formulate and to carry through an effective program of this type, designed to reverse trends that have been operative for many decades, the rewards—both human and economic—should make this challenging task well worth while.

Summary

The core of the economic problems of the aged and our aged population is found in the fact that opportunities for gainful activity of older persons have not kept pace with the strikingly rapid growth in our aged population in recent decades. The evidence to date offers no facile hopes for reversing or even halting the long-term historical trend, particularly in the decline in labor force participation of men 65 years and over. The goal of widening the scope of employment opportunities for older people is a feasible one, providing that we develop and apply positive measures for extending the period of working life.

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Geriatric Medicine: Therapeutic Aspects

A Panel Discussion by:

M. W. Warren,

W. B. Kountz,

L. A. Pratt, and

E. J. Stieglitz

Second International Gerontological Congress and Fourth Annual Scientific Meeting of the Gerontological Society, Inc.

Monday Morning, September 10, 1951

EDITED BY E. J. STIEGLITZ

The group convened at ten forty-five o'clock, Dr. E. J. Stieglitz of Washington, D. C., and Dr. Marjory M. Warren of Middlesex, England, presiding.

CHAIRMAN STIEGLITZ: The assignment given this panel by Dr. Kirk was to attempt an informal, unplanned, unrehearsed, and, we hope, argumentative discussion of some of the aspects of therapy in geriatric practice.

Therapy may be analyzed, first, on the basis of techniques of application. Specialization in medical practice has been developed both on the basis of technique, (surgery as contrasted to internal medicine), and on the basis of anatomic area (ophthalmology, urology, dermatology, neurology, et cetera).

Techniques of therapy include the application of drugs, surgery, nutrition in its broadest sense, psychotherapy, et cetera. Thus in inviting the members of this panel we hoped to have various areas of therapeutic methods represented. Dr. Kountz, on the extreme right, (which does not necessarily make the extreme left politically left), is going to focus his attention primarily on the nutritional and endocrine aspects of therapy; Dr. Pratt, as a surgeon, on the problems of surgical intervention in the treatment of the aged; Dr. Warren, on medications, physical medicine, and the problems of rehabilitation. The hot spot will be taken by myself: the role of psychotherapy for older individuals.

Another way of analyzing therapy is to attempt to analyze its objectives and purposes. In geriatric medicine there arise purposes in therapy differing from those that we consider in other areas of medical practice. At least there is different emphasis on certain objectives. One purpose is active therapy for an immediate situation. First is a presenting complaint in an acute illness, which is modified by the fact that the individual is an older person. Secondly, and particularly important, is prevention, or anticipation, or health construction, of the relatively well, not disabled individual. Thirdly, there is the purpose or objective of rehabilitation after an acute emergency is over.

It was the consensus of the four of us here yesterday, when we outlined a few questions to ask each other, that we should emphasize the second of these purposes. We could not agree on whether to call it health construction, anticipatory, or preventive medicine in the broadest sense. It is really immaterial what label you put on it, but anticipation implies foresight in the avoidance of more or less predictable difficulties.

It is recognized that one cannot segregate therapy from diagnosis, because comprehensive therapy is dependent upon a comprehensive diagnosis. And in the older individual we may

violate the rule of never using "never" and "always" by saying we never find a single disorder. If we do, it is so rare that the occurrence is insignificant. The individual has multiple, previously accumulated injuries, handicaps, and scars of prior illness, which affect the clinical picture. Invariably when dealing with an older person therapeutically, we deal with a group of problems, each of which affects the others and these interactions modify the course.

I should like to outline briefly the technique of our discussion here this morning. Each of the participants is to have from two to ten (but not more than ten) minutes to present his or her ideas as to what the therapeutic highlights are in each particular assigned area. Then we want to ask each other questions and try to provoke some differences of opinion. It would be appreciated if questions from you, as participants in the discussion, would be written. We thought that in about forty minutes we would have a five-minute stretch; at that time the written questions could be handed up to be discussed after a brief intermission.

If that is agreeable to you, I should like to ask Dr. Warren if she would start off with telling us her philosophy.

DR. M. W. WARREN: I think the principles of therapy depend primarily on getting a thorough and complete diagnosis. Getting a complete and accurate diagnosis depends on getting a complete history. Getting a complete history depends on a time-consuming meticulous care of detail, both on the part of the individual who takes the history and his intimate contact with the patient. With regard to elderly patients, I think you have to let an old person talk, rather than get him to try to answer specific questions. It is sometimes only out of a long talk that you will be able to evaluate what are the important factors in that history.

In addition, it is necessary to get a history from a relative or some friend who lives with the patient and who can often evaluate the psychologic aspects of the patient's problem. It is necessary to get certain facts pertaining to the past history and also to get some idea of his social background, occupation, and environment.

As Dr. Stieglitz has already indicated, in the older age group it is general and usual to find a number of complaints. It is important to get all those lined up in your first picture of that patient.

In thinking of therapeutics there must be no prejudice because of the patient's age. In other words, you must not regard a patient with a defeatist's attitude just because he is over 90. There must be no prejudice in the matter of the condition in which the patient presents himself nor yet in the length of time that he has been complaining about that condition. What I mean is that the fact that a patient presents himself with an arthritis of ten years' standing does not mean that you cannot, in some way and perhaps to some considerable degree, alleviate that condition.

I think that the conditions presenting themselves will probably fall into two groups:—the primary complaints (usually due to the disorder or disorders with which the patient presents himself with a predominating sign or symptom) and the secondary symptoms and signs which may become apparent only during your clinical examination. A patient may present himself with arthritis and its associated disabilities and be found on a clinical examination to be suffering also from a macrocytic anemia and perhaps also diabetes which requires attention.

In addition to these two aspects of overlapping disorders in the patient you must think of those conditions which you know from your own experience may develop during the course of observation and treatment in an older patient. I would stress here particularly the question of contractures. It is not at all unusual for a patient to come in with one condition, and, unless the physician is aware of the possible sequelae, which may arise while the primary condition is being treated, secondary conditions in the form of contractures (and I include not only somatic but also mental contractures, that is, defeatism and the feeling

of frustration) may develop. There is also the problem of education of the patient toward his own disability, which must be attended to from the first time that you see him.

In other words, in treating a patient I cannot too strongly emphasize the necessity of treating the whole individual from the point of view of his physical disabilities, from the viewpoint of his psychologic adaptation and from the educational aspect with regard to his own complaint, or complaints.

My own teaching has been for many years that in dealing with older people there are few conditions which you can cure, but the large majority of conditions can be remedied or improved. A patient, therefore, has to be rehabilitated in the fullest sense of the word, as far as it is possible with the present knowledge of medical science to rehabilitate that patient; and secondly, he has to be taught to live intelligently with his residual disabilities, whatever those disabilities may be.

From the very beginning, therefore, in guiding the therapeutics of a patient, one has to think of the supervision of both the physical side and also of the psychologic side.

I believe it is important also to think in terms of activity with regard to old people. This can start the very time the patient comes in. It does not necessarily mean the active physical exercise which is often associated with physical medicine. It means the activity which necessarily should be undertaken in a patient's washing of himself, brushing his hair, brushing his teeth, putting on his clothes. I think we should operate on the principle that no patient is to have done for him anything that he can do for himself and which he should be allowed to do within the confines of his disability.

There are, of course, obviously, times when a patient should be given absolute rest for a short period of time; but as soon as that period is over, if he is able to feed himself, he should be encouraged to do so, both from the physical and the psychologic point of view.

These, I think, are the major general principles upon which I would start the treatment of any and every patient coming to my care.

CHAIRMAN STIEGLITZ: Thank you, Dr. Warren.

Dr. Kountz, can you given us some of your philosophy as regarding the nutritional and endocrine therapeutic problems in the elderly?

DR. W. B. KOUNTZ: The problems, primarily, that have to do with nutrition and the endocrine aspect of aging, seem to me to resolve themselves into several different categories, depending apparently on, in part at least, the state of health of the individual. Perhaps we could even say "depending upon the age of the individual," because as one grows older, we all know that the state of health and nutrition fairly closely parallels chronologic age. That is not absolutely the case, but generally we can say that.

As Dr. Stieglitz pointed out initially, what are we going to do for this patient? That is the point we must ask ourselves. My point of view is this: that we should try to prevent the degenerative changes which occur with age. This is a very difficult procedure at the present time, and one whose effectiveness is questionable, but I think we can perhaps clear up some of the points, or at least help in that direction, by establishing a reasonable process in the preventive field of medicine.

My point of view is that health is, in part at least, dependent upon the glands of internal secretion, and that very likely the initiating factor of most degenerative changes that occur in our bodies is based upon the changes in the glands of internal secretion and the enzymatic factors that go with them. In other words, thyroid secretion probably has dual enzymatic action. It is known to induce certain chemical stimulation. The enzymes probably are the keynotes to the activity of the hormones.

Enough for that, except to say that I think in the field of nutrition endocrine evaluation is extremely difficult. We know some of the factors operating at the menopause: the personality changes, the tendency to become obese, and other fundamental changes that slowly creep in which we are just beginning to under-

stand. The diminished supply of the androgens and estrogens from the body means that the individual becomes more likely to develop a negative nitrogen balance.

If he has a cold, or if he has other infection, if he undergoes emotional strain, or if he starves himself, there will be a decline in his protein reserves and/or in his ability to utilize protein. There will therefore occur a wearing out, or exhaustive process, as far as the body is concerned. This can be prevented by carefully watching the status of these hormonal substances in the body by studying prostatic smears, by evaluation of the glycogen content of the cells of the tongue, the vagina, and so forth.

I am not going to talk about the dangers of glandular overactivity at this moment, but I shall a little later.

With the menopause a change in thyroid activity is the rule rather than the exception. You can expect to find one of two types of change. You can have hyperthyroidism, but much more commonly you will find hypothyroidism if you look for it. My experience with hypothyroidism would indicate that it is a much more serious condition than one ordinarily thinks, particularly from the standpoint of vascular disease. It seems to me that one of the most important points to be borne in mind is that we should try to control thyroid insufficiency, or at least the rate of oxygen consumption, and always attempt to adjust that to nearly a normal level.

One criticism of basal metabolism as a criterion for health is that it is difficult to interpret. It is a difficult test to make, because as an individual develops degenerative changes, his rate of oxygen consumption, as a compensatory mechanism, tends to rise because of body strain.

Let me give you an example. If we were to take a patient and inject air into his chest (say we had taken his metabolism before and we had found it to be minus 10, and then we injected 1000 cc. of air into his chest) he would not become dyspneic, but parallel with that air injection there would be a rise in his basal metabolic rate, due to the fact that this handicap throws a strain onto the organism. And if you take that air out, the metabolic rate or rate of oxygen consumption will drop to prior levels. Thus strain due to many degenerative diseases introduces an error that is difficult to evaluate.

We have other techniques, of course, of evaluating thyroid activity, such as the rate of pickup of iodine and the blood iodine level, but I shall not have time to talk about these at the moment.

I think hypothyroid function and lowered metabolism are something we should learn to prevent. We should pay much more attention to the basal metabolic rate and to the rate of oxygen consumption than we have done previously.

Another most important facet, as far as nutrition is concerned, is the change which occurs in the glucose tolerance. It has been our experience that the individuals who most frequently give us a high glucose tolerance test will have a longer period of health than those who have abnormal tests.

There are seven types of abnormal tests seen in the oldster. We don't have time to discuss them, but it is perfectly possible to shift even from the extreme diabetic curve to a normal curve by the use of diet and insulin, and it is also possible to shift from the other types of abnormal glucose tolerance curves to normal curves by diet and other techniques. In other words, we can hope to maintain in our patients a fairly normal glucose tolerance curve.

The use of corticoids, particularly, is of importance. I will take just a moment to trace my opinion of what role the corticoids play after menopause and as to the development of some of the deficiencies.

As you know, when the sex organs diminish their activity, the adrenal gland tends to take over the job of producing folliculoids and androgenic substances. Many times the adrenal cortex is not fully capable of doing this. It may have to neglect some of its other functions and oftentimes it neglects its real job of

producing the mineral corticoids or the glucocorticoids. As a result we develop skeletal changes, demineralization, and so forth.

Finally, I want to add that it is very difficult to make these metabolic diagnoses, but I hope to try to point out to you later the way I think geriatric patients should be handled in connection with their nutrition and hormone balances.

CHAIRMAN STIEGLITZ: Thank you, Dr. Kountz.

Dr. Pratt, will you tell us something of your personal philosophy concerning the principles of surgery as applied to the older individual?

DR. L. A. PRATT: Dr. Stieglitz, Ladies and Gentlemen. Age in itself is not a contraindication to surgery. Almost any surgeon would prefer the lean, lanky, lusty individual of 70 to some of the fair, fat, and florid 40 year old individuals with mild cyanosis that we are sometimes called to operate upon. Let me reiterate: age in itself is not the important factor in evaluating a surgical risk.

Our concepts have changed. Fifteen years ago we considered that 45 was arbitrarily the upper age limit for thoracoplasty in tuberculosis. Today we do not believe that any more. As a matter of fact, we are undertaking rather extensive excisional surgery without primary regard to age.

The surgeon, in evaluating an operative risk, must necessarily consider certain predictable problems that he will encounter and must provide adequate safeguards against those complications that he can anticipate with considerable certainty.

Dr. Warren has pointed out the importance of the history and, incidentally, the preoperative evaluation of the aging patient. We believe that during that preoperative period there are certain things that can and must be done. Many of these individuals have faulty eating habits. It is not unusual to see an elderly patient who has existed on a diet of crackers and tea for a long time. We know that his proteins are down. It has also been pointed out that the ordinary calculated protein intake for the average individual is not enough for these people. They need a lot more than that.

Thus a careful evaluation of the patient preoperatively, system by system, bringing his nutritional state into the best possible balance, is a primary part of evaluating his surgical risk and preparing him for the surgical procedure.

There is also something else that can and should be done, in the way of preoperative rehabilitation. Many of these patients are shallow breathers; have impairment of their respiratory systems. We believe that we can do a good deal toward improving their chances of effective results by instituting remedial breathing exercises, just as we did in the severe chest trauma cases during the war.

Another thing that it is important to undertake preoperatively is evaluation of the individual patient's response to drugs. Dr. Warren knows a great deal more about this than I do, but we all have occasionally seen the patient who exhibits severe reactions to small doses of various drugs. If such intolerance can be determined prior to surgery, it is an immense help. Postoperatively the margin of safety is much smaller.

The next point I would make—and this one cannot be overemphasized—is the importance of anesthesia. I will say bluntly that it is not enough for an untrained or poorly trained anesthetist to say, "Doctor, what kind of anesthetic do you want this man to have?" because the surgeon, in general, is not trained in anesthesiology either. The trained medical anesthesiologist is the only one able to carefully evaluate this operative risk. If we are going to do anything for these older people surgically, it will be because of the availability of the services of well-trained anesthetists.

In general, it does not make much difference what primary anesthetic agent is used. The trained anesthetist can determine that. For hemorrhoidectomy certainly, he is not likely to use a spinal. His limits of spinal anesthesia will be determined by the level at which the surgeon may work. He may elect to use cyclopropane. He may use sodium pentothal in conjunction with curare, or he may use

ether. But remember the anesthesist has three problems in this patient that he must consider: first of all, he wants him to have adequate oxygen; secondly, he wants no interference in getting rid of the CO_2, and thirdly, he wants to use the minimal amount of preoperative medication or anesthetic drug that he can, consistent with enough relaxation to permit the surgeon to work. Failure to recognize any one of those problems may lead to disaster.

The postoperative rehabilitation of this patient is extremely important also. We consider, in general, that these patients should be encouraged to early ambulation, and that their habits should be adjusted at an early date so that their nutrition is maintained. Any necessary nasal tube for the administration of nasal oxygen, or the gastric tube, should be removed early. We believe that this tube interfers with the cough reflex. It is not uncommon to see neglected nasal tubes get the patient into serious difficulty. If they have retained secretions and they are not able to cough from the mouth, we do not hesitate to insert a bronchoscope and repeat the bronchoscopy as often as is necessary to keep the air passages clear and clean.

In summing this up, Dr. Stieglitz, you asked for an expression of a philosophy. If teamwork is desirable in surgery upon a younger individual, it is mandatory in surgery for the aged person. That teamwork must be between the internist, the nutritionist, the surgeon, the cardiologist, the radiologist, the anesthesiologist, the social worker, who can carry this patient through the postoperative period and adjust him again to his environment, and those who are interested in rehabilitation and undertaking the job of restoring this individual to society.

CHAIRMAN STIEGLITZ: Thank you, Dr. Pratt.

My own assignment is to discuss some of the psychologic factors that we have to deal with in older individuals. I should like to preface my remarks by saying that we all know that there are changes in the homeostatic capacity with aging: the ability to compensate for stress, the ability to maintain an internal equilibrium. In the physical sphere, to a great degree these homeostatic compensations become less effective with age; in the psychologic sphere, in the normal individual, they become more effective with age, and therein lies a most significant difference.

A very important thing to keep in mind constantly is that with the highly desirable attitude of anticipation and prevention, we must be aware that there are many predictable, highly probable, psychologic traumata that are concomitant with senescence. These traumata are going to occur to almost every one of us, or to every one of our aging patients. I prefer to use the "us," because we too are involved. Because these stresses can be predicted, we have the opportunity and therefore, the responsibility, of building defenses, anticipating, and educating our patients in advance of the traumata.

Every experience that an individual undergoes, whether physical or otherwise, has potentialities for destruction and catastrophe, and simultaneously potentialities of benefit or construction. I think there has been an unfortunate emphasis of the concept that all emotional injuries or traumata are necessarily destructive. They can also be constructive. I like to use as an example the fact that fear may be extremely destructive. But, on the other hand, if anyone can tell me how any individual can develop courage without experiencing fear, I should like to know how it can be accomplished. Courage cannot exist without fear, and it certainly cannot be cultivated. So fear in itself is a very useful and constructive phenomenon if properly utilized by the individual.

Among these anticipatable traumata are (this is not by any means a comprehensive list):—First, the loss of children who grow up and leave home. This means for the middle-aged woman the equivalent of retirement from the most significant task that she will ever have in her life. She is retired from doing anything which is particularly significant, and her loss of purpose creates a very

difficult situation. Unfortunately, this phenomenon of unrecognized retirement so frequently occurs coincidently with the climacteric that the climacteric, being the most convenient diagnostic wastebasket, is blamed for everything that happens to a woman between the ages of 40 and 60. In most instances the climacteric probably—and Kountz may disagree with this—plays a relatively minor role in the genesis of the difficulties.

Secondly, there occurs loss of parents, which we can anticipate. One generation outlives the preceding one. Though ordinarily this is not especially stressful, such loss may be exceedingly traumatic if there has been an exaggerated and too long-continued child-parent dependency into mature life.

Thirdly, we must consider the now more common, more complex, and much more difficult problem of excessive survival of parents. Care of a senile and infirm parent constitutes an indeterminate sentence. And the fact that it is an indeterminate sentence is particularly important in the case of a chronic infirm, confused invalid in the household. This responsibility is not necessarily for only three or four years. After all, a mother who has two or three brats knows that in five or six years they are going to go to school, and she will have a little opportunity to do her own living. With the aged one doesn't know how long the sentence of continuing care is going to last, and the psychologic damage done to both generations is immense.

A fourth predictable emotional hazard of senescence is the huge area of retirement. Retirement for the male is more formal than for women. But retirement of a man is often an extremely difficult problem for his wife, because for many years she has had the opportunity of having peace and quiet around the place for eight to ten hours a day, and then all of a sudden she has this bored discontented man underfoot twenty-four hours a day. As one patient put it to me—and she was not intending to be facetious—"Doctor, do you think that we ought to set up a den for Joe, or let him growl all over the place?"

We have also to face the predictable problems of loss of beauty, of sex appeal, figure, prestige, authority, and the like. And there are many more stresses. One particularly pertinent here arises in connection with what Dr. Pratt just said. With the tremendously increased effectiveness of surgery in the purely somatic sense the older individual can anticipate undergoing what to the patient may be a mutilating, even though life saving, operation. Such an operation is not necessarily mutilating from the medical point of view, but the patient may feel that it is. For example, mammectomy, hysterectomy, or prostatectomy, may imply unsexing and be seriously psychologically traumatic if misunderstood by the individual. Here we can anticipate the potential emotional injury and point out that a hysterectomy does *not* mean unsexing. There are a great many women who think that they are no longer women after they have had a hysterectomy.

Because these potentially traumatic experiences are predictable, they are amenable to prevention. It requires foresight on the part of the physician, and it requires effort in instruction. We may say that psychologically aging, as it exists today, is the equivalent of a whole long series of partial amputations of capacities. It is as though one lost part of a finger and then more of a finger and then other capacities. We are constantly being disabled, in a gradual, insidious manner. To a certain degree aging can be contrasted to diving into cold water, and inching in one step at a time. The latter method makes you feel the cold all the more.

The greatest problem emotionally lies in the immensely significant asymmetry of maturation:—individuals do not mature physically and psychologically symmetrically. We hear much of so-called second childhood in the senile. I insist it is not a second childhood. It is the first childhood which is continued without interruption but had been concealed by extreme conventionality of behavior throughout young maturity. We find the childish seniles have always lived ultra-conven-

tional lives, patterning their ideas and activities solely upon what they think the herd would think of them. They never do any of their own thinking. Experience leads one to consider extreme conventionality *a priori* grounds for suspicion of immaturity.

A very important psychologic facet is the failing memory which comes with age. This is significant in practical therapeutics. Instruction must be clear, concise, and better written out. However, the depreciation in memory with age is not as great as many of us assume. There are other factors involved. One is motivation, interest, or the apparent significance of what they are trying to remember.

Another very important element is failing of the senses. Acuity of perception declines. Not infrequently instructions are confused because they are not understood due to an impairment of hearing. This must not be confused with a failing of memory. Instructions or explanations may never have been registered in the first place. From the practical therapeutic point of view, this makes it absolutely imperative to remember that when the elderly patient consults the physician, the old man is excited, confused, and undergoing what is to him a confusing and exciting procedure. If under these circumstances one gives him a long list of verbal instructions, the great majority of them will not even be registered, much less followed. I am not speaking now just about a prescription for drugs but of the more important instructions on how to live. These should be written. Other members of the family or household should likewise be informed, so that instructions may be carried out with some degree of accuracy. It is a wise thing to note on one's own record what instructions were given, so that one can check back and see if they were actually carried out.

Failing memory is also particularly important in interfering with getting an accurate clinical history. Many experiences are forgotten, not necessarily willfully, but unconsciously, because they were unpleasant. It may be necessary to go over the story of the patient's past again, and again, and again. Extraordinarily, on the third or fourth going over of the past history of the individual, one may obtain the most significant and vital information, which affects the whole clinical picture.

Habits play a very important role in the management of the elderly, both psychologically and somatically. It is hazardous to attempt to change habits abruptly. Habits of life—habits of eating, and the like—if changed too abruptly, can upset the applecart, with disastrous consequences.

We also have to make certain adaptations to prejudices. They are so deeply ingrained that we can waste all our efforts in trying to overcome the prejudices and thus really miss the important point.

Among habits and prejudices which profoundly effect the clinical problem those regarding dietary fads are of special importance. Dr. Pratt mentioned tea and crackers. I once saw professionally an alert healthy 85 year old gentleman, who had lived twelve years, because of his food fads, on nothing but pineapple juice and bacon. I do not know how he did it, but he *was* in excellent health. Our theories of nutrition were seriously challenged. The fact that he succeeded should not be ignored. The aged have learned to live with themselves, and thus their own prejudices and habits have a certain value.

I should like to emphasize these essentials to good geriatric therapeutics: Number 1:—listen, listen, listen patiently to what the patient has to say. Secondly, they need reassurance, and one cannot avoid a certain degree of dependency. I am certain the elderly need instruction with reassurance. Particularly do they need to be convinced that use encourages development and that disuse makes for atrophy. If that idea can be hammered in repeatedly, it assists any long-term program.

And also let us be honest. Mature individuals accept reality far better than the young. They are entitled to honesty, and they are entitled to be told that there are limitations on what can be accomplished. We should not

promise more than what we have a right to expect.

There has come, in geriatrics particularly, but also in the whole new area of medicine which we might call the anticipatory approach, an increasing shift from the dogmatic physician-patient relationship to the teacher-student relationship. The physician, to accomplish as much as knowledge makes possible, must become a teacher by instructing his patients in how to live.

Now we want to go on to some of the questions that we had planned to confuse these issues. I should like to start asking for a volunteer for this particular question, because fools can ask questions that wise men have difficulty in answering.

The question is:—

"Where, in your opinion, should geriatrics begin?" Who will volunteer?

DR. KOUNTZ: I would say at least by the age of 40, maybe even earlier, depending upon the factors of nutrition, which in turn may depend upon endocrine competence.

CHAIRMAN STIEGLITZ: Any disagreement?

DR. WARREN: It depends on whether you want an answer from an academic point of view or from a realistic point of view in connection with therapeutics. Academically, one must start before birth, because certain cells start failing and die before birth. If you want the answer from a realistic or therapeutic point of view, I would tend to put it at least over age 50.

CHAIRMAN STIEGLITZ: Do you want to get into this, Dr. Pratt?

DR. PRATT: Well, I am willing to place it at any age for a given individual where you can predict or anticipate senescent changes in that individual. For one individual it is going to be over 50, and for other people it is certainly under 40. And I am personally convinced of what I said in my opening remarks: that chronologic age in itself is not the determining factor, because we certainly see many examples of young individuals who are old, and we see many examples of old individuals who are young.

CHAIRMAN STIEGLITZ: Dr. Warren, would you give us your reactions to the use of sedatives for older individuals?

DR. WARREN: I think sedatives have to be used with extreme care. My own experience is that very small doses will often accomplish all that is necessary. I think older people are very sensitive to the barbiturate drugs. It is extremely easy to precipitate a pre-uremic state before you realize what is happening.

I think the dosage and the timing of sedatives are important. Sedatives given too late at night will continue to act during the following day, during the period of time when you want to have your patient active in connection with his nutrition and other forms of therapeutics. Then one is left once more, when night approaches, with a restless patient who, for the sake of the other patients and perhaps the staff, too, must be given further sedation. I would therefore give the necessary sedatives in small doses, starting with too small doses rather than too large, and give them quite early if they are needed for the night.

CHAIRMAN STIEGLITZ: What would be your sedative of choice, on the whole? There would be specific variations, of course, but you may have some general preference.

DR. WARREN: I would start with very small doses of phenobarbital.

CHAIRMAN STIEGLITZ: For nocturnal sedation?

DR. WARREN: Yes.

CHAIRMAN STIEGLITZ: I can't agree with you.

DR. KOUNTZ: I can't, either.

CHAIRMAN STIEGLITZ: I think that alcohol, paraldehyde, and chloral hydrate are probably the best for nocturnal sedation, with alcohol first on the list. They are probably the safest and the most effective, presenting the least carry-over. I would condemn particularly the barbiturates and bromides, because of their tendency to confuse and accumulate.

DR. WARREN:— I think patients vary quite a lot. Some patients will react better, in my experience, to chloral, and others will get no effect from chloral, but will react very well to a small dose of barbiturates given early enough.

CHAIRMAN STIEGLITZ: One of the advantages of paraldehyde, particularly for the patient at home, is that it is so highly disagreeable that they rarely exceed the prescribed quantity.

Dr. Kountz, I wonder whether you would comment on whether, in your opinion, the sex hormones play a primary, secondary, or negligible role in the phenomena of senescence.

DR. KOUNTZ: I should like to start out by disagreeing with your previous statement that the psychologic stresses coincidentally effecting menopausal women is something more than a very definite medical problem. In my opinion all the advice in the world will, in many instances, do no good whatsoever, but that judicious application of sex hormones oftentimes will turn the tables entirely.

I think that basically the problem of many of the changes that occur in old age is related to disease, which is difficult to trace; to an obscurely deficient nutrition of the tissues, perhaps of the brain. Just as we can demonstrate the lack of sugar or glycogen in certain epithelial cells of the body, it is probable that if we could take a smear of the brain cells, we could likewise demonstrate an alteration in the nutrition of these cells or their glycogen content. So I certainly disagree with you that the enzymatic and hormonal changes are of secondary significance.

Another point that I do not believe has been covered as yet concerns a problem on which I know we agree. I agree that the clinical history and physical examination are extremely important, but I think that only by accurate, careful, detailed laboratory study of such factors as the glucose tolerance curve, blood sugar levels, and basal metabolism can we hope to institute real health in the older person. And I think we are just fogging the issue when we say, "Get a good history" because, in the first place, he oftentimes can't give you a good history because of the factors that you have just spoken of. I think that the point to remember is that it is necessary to go after the diagnostic problem by a fundamental evaluation of the physiologic aspect of the organism.

But, to answer your question, I think that the sex hormones do play an indirect, but very important, part in the initial development of senility and the initiation of the forces that lead to it. They perhaps are not prime factors in causing the change, but indirectly they contribute significantly.

Does that answer your question, sir? (Applause)

CHAIRMAN STIEGLITZ: I am not going to defend an opposing thesis now, because there are too many facets involved. But I am sure that Dr. Warren and I, Bill, did not intend to imply that a clinical history sufficed for accurate and comprehensive diagnosis. We need the actual factual data *in addition* to the history and physical examination. But we do gain a great deal of insight into the individual as a whole by an intelligently interpreted history. If we are going to treat the patient and not just his diseases, we need all the information that we can get, from all sources. I am sure you would agree to that.

DR. KOUNTZ: Yes.

CHAIRMAN STIEGLITZ: I am sure you will also agree that we didn't mean to slight the importance of laboratory data.

DR. WARREN: Yes.

CHAIRMAN STIEGLITZ: Dr. Pratt, in the last few years we have seen in surgical practice a tremendous change in the prescribed duration of bedrest and convalescence. Early ambulation has, apparently, resulted in a very definite improvement in prognosis. I wonder whether you would care to comment on *why* early ambulation postoperatively is so valuable.

DR. PRATT: Before answering that important question, there is one point I want to pick up that fits what we are talking about. I don't think you can say that the history is the only thing that is important or that the laboratory examination is the only thing that is

important. They are all significant. But we must not overlook that this patient must be evaluated clinically. One can look at this individual, pick up his skin, and it stays picked up. That means that he is dry, that he is dehydrated. You can feel his eyeballs, and they are soft. That means that his electrolytes are out of balance. You can take his blood pressure, and it is low. That may imply that he is dehydrated. These are simple things that you can and must do in the clinical evaluation of any patient. Furthermore, you can ask him to walk across the room and back, and observe carefully what he does. These are all valuable sources of information that we all have at our disposal.

Rehabilitation, as far as surgery is concerned, must start before operation and it must continue after surgery.

We were talking a moment ago about teamwork. Dr. Stieglitz, I did not leave out the psychiatrist and the psychologist because I deny their existence. I forgot them for the moment.

CHAIRMAN STIEGLITZ: Probably a very safe thing to do at times.

DR. PRATT: We believe today that an elderly patient does not well tolerate a change in his habits from a life of relatively continuous activity to complete bedrest. The sooner you can get him out of bed, in general the better. Dr. Warren will agree with this, but it is not a rule without exception.

We know, and this has been demonstrated repeatedly, that the longer you wait to immobilize or nail a hip, the greater the incidence of fatal embolic phenomena. That means that these patients *must* be nailed early, or immobilized, or fixed in some way, so that you can start them moving. It is so important that they must be forced to move, even if you have to nearly beat them over the head with a club to arouse anger. This is usually easier to do with older persons. You can irritate elderly patients to the point where they will get mad at you and get out of bed to spite you. This is just what is desired. We feel that the more motility you can get and the earlier you can get it, the better it is.

Now, of course, there are exceptions. The patient who is already in trouble from emboli—I don't believe you should move him too fast or too early. You are likely to get into even more serious trouble.

Another problem that I want to mention briefly is that we are seeing more and more tuberculosis in elderly patients all the time. The fundamental principle of treating tuberculosis is rest. Occasionally you may have to sacrifice something and compromise with theoretical principles. It may be disastrous to take the elderly tubercular who has been active, and suddenly put him at complete bedrest, not even letting him go to the toilet. We must modify our thinking to coincide with the present problem.

CHAIRMAN STIEGLITZ: Dr. Warren, I wonder whether you would carry on from that point as regards advantages and disadvantages of increased activity, early ambulation, or whatever you want to call it, following, let us say, a cerebral accident. Immobilization is not necessarily postoperative, but may occur for reasons other than surgical.

DR. WARREN: I would emphasize the importance of insisting upon activity of some sort from the very beginning after a cerebral accident. The activity can be of various sorts. I would not take a patient who has had a cerebral catastrophe today and try to get him right out of bed and get him to stand, but there are no reasons why he should not be actively employed in doing such things as he can for himself. He may be encouraged in the very early days to get into his clothes, probably at first, with help.

I personally draw a great distinction between a patient being *in* bed and *on* his bed. In the early stage, after a cerebral accident, it is much easier for a team of workers to supervise the position and avoid malpositions in a patient if he is lying in a dressing gown *on* the outside of his bed instead of being tucked in neatly under the bed clothes, where you can't see a malposition beginning.

I am also sure that the earlier you start with a conscious patient in telling him that he is going to soon begin a well-planned pattern of exercises in which he is going to play the most important role, the better. I generally tell my own patients that while I am there to advise with what experience I have, to insist on their cooperating and even take the part that Dr. Pratt mentioned by irritating them, if necessary, to get them on with their exercises. The final result is going to ultimately rest on their cooperation. It is immaterial if temporarily they are really cross and fed up with me. The ultimate results are what count.

CHAIRMAN STIEGLITZ: You might apply, then, therapeutic rage as a stimulant to a hypertensive patient recently involved in a cerebral hemorrhage?

DR. WARREN: If it were necessary, yes, because the alternative is to accept his noncooperation, at which time he will lose valuable time and develop contractures which may be ultimately irremediable. He may also develop an attitude in which he considers himself as being untreatable. Eventually, if he comes around to your way of thinking, which may not be for several months hence, you will probably have permitted a condition to develop which you can't possibly remedy. I think, therefore, you have to keep at these patients until they do understand that you know something about their problem.

But I would emphasize, as I think you did in the beginning, that you must be very honest with the mature patient. I would never tell a patient, unless I did it ignorantly, that he might achieve a goal of any kind unless I was perfectly certain that that was within his power. I do that for two reasons: partly from the point of view of being honest with the patient and partly from the point of view of not losing prestige myself. And I think one's prestige with one's own patients is a very important thing, because in that is bound up their confidence in you as a physician. If you promise that they will do something which ultimately proves not to be true, they no longer have any confidence in what you advise them.

CHAIRMAN STIEGLITZ: We promised you a five-minute stretch; and although we started late because the previous session ran overtime, I think we should plan on closing at twelve-fifteen. Therefore, if we want a five-minute stretch and some questions passed up from the floor, it seems to me that now is an appropriate moment.

(Recess)

CHAIRMAN STIEGLITZ: We have several questions here from the floor, but before I ask these, there have been two or three points that have been brought up here that I think could be amplified with profit. The question of the importance of immobilization in leading to bone destruction and failure of healing, et cetera, was mentioned. I wonder, Dr. Kountz, whether you would discuss the nutritional and glandular aspects of treatment of the osteoporosis and demineralization which occurs postmenopausally, in the aged.

DR. KOUNTZ: Several factors have been shown to lead to osteoporosis. As you know, hyperthyroidism is one factor, as well as hypothyroidism. In addition, a lack of estrogens, and, particularly, a deficiency of androgens, favors the production of this condition in older people.

The simplified story of what goes on in our bodies as we age is a slow, steady decline in calcium, or progressive negative calcium balance. Just as we observe a negative nitrogen balance, we likewise have, beginning at the age of 35 perhaps, a progressive loss of calcium. This seems to parallel pretty closely the decline in estrogenic substances and androgens consequent to the decreased functioning of the sex glands.

Of course, treatment is by insuring an adequate calcium intake and at the same time the application of sex hormone substances. Recently we have tried a high calcium intake to see if one could compensate for the estrogenic loss in older people, and we find that such compensation can be accomplished only if the calcium intake is extremely high. But this is rather undesirable, and we are convinced that the administration of estrogens and androgens

as a precautionary factor in osteoporosis is definitely indicated.

One might comment on the role of vitamin D and say that perhaps it should be administered in moderation. But vitamin D has no significant place in the treatment of osteoporosis.

CHAIRMAN STIEGLITZ: Thank you.

Now to turn to some of these questions from the floor. I am very sorry that we may not be able to get to all of them—the time is short—and also regret exceedingly that we cannot call for comments from our audience, although there are many here who know as much, or more, about geriatric therapeutics than any of us up here. The roles could very well be reversed in many instances.

The first question is:— "What proportion of elderly patients present nutritional problems?"

Let us take a vote on that one. My estimate would be 99.4 per cent.

DR. WARREN: I think it is very high. Of course, it depends a little on the social status of the patient. It is not money only that enters into nutritional defects of old people, but inaccessibility of food due to their infirmity and far-away shops, and so on.

CHAIRMAN STIEGLITZ: Habits being one of the "so on" factors?

DR. WARREN: Habits, yet.

CHAIRMAN STIEGLITZ: What would be your estimate, Dr. Kountz?

DR. KOUNTZ: It would certainly be high, and that is one of the reasons why diet is so important. As previously mentioned, there is great individual variation among the elderly and therefore their diets should be adjusted individually. That is one of the reasons we need our laboratories to guide us as to what is happening within the body. The ideal adult individual who is not in a state of malnutrition is somebody who is under adequate medical care. I think in 100 per cent of those who are not under proper medical care, one could find nutritional deficiencies.

CHAIRMAN STIEGLITZ: Thank you, Bill, for agreeing with me.

Dr. Pratt, not infrequently we are presented with acute nutritional deficiencies both pre- or postoperatively, where there is no time to build the patients up by diet. However, we now have the ability to introduce intravenous serum protein, blood, glucose, and the like. There are also occasions where the facility with which intravenous injections may now be done may lead to abuses, and perhaps too rapid administration. I wonder whether you would care to comment on the pre- or postoperative intravenous application of blood and nutrients.

DR. PRATT: That is a big problem.

CHAIRMAN STIEGLITZ: I know it is.

DR. PRATT: I don't think we know the whole answer, but the problem really hinges around "How big is the hurry?" Certainly, the best way to get protein into an individual is through his gastro-intestinal tract. There is no question about that in my mind.

I am very positive when I say that, and every time I get positive I go back to Ambrose Bierce's "The Devil's Dictionary" and look up the definition of "positive." There it says "Positive: wrong at the top of your voice." But anyway, that is my conviction, even to the point where on occasions of high intestinal obstruction, such as of the cardia, we have done a preliminary gastroenterostomy for feeding purposes in order to get protein into the gastro-intestinal tract before attempting much more extensive surgical procedures.

But, if the need is urgent and time is the essence, and you *must* get protein into the patient quickly, (I may be very wrong about this one, Dr. Kountz) I think blood is the way to get it in. We have all sorts of protein derivatives that can be given intravenously, including the serum albumins and amino acids, and thus we can get rather high protein concentrations directly into the blood stream. But we must always remember that the amount calculated for the ordinary individual is not necessarily enough for the older individual. He must have a lot more than the younger person. Maybe twice as much. I don't know. But, if one is not very careful, one will soon have his veins in such terrible shape that one

cannot use them. So I think the safer rule is to give whole blood. I do not believe one needs to give salt or lactose or glucose into the veins, because one can give it subcutaneously, adding hyaluronidase to it, and get good absorption. However, it is important to remember not to overload the elderly patient with water.

I did not formerly believe that an individual could drink himself into overhydration if his kidneys were working, but now I know that one can. If you load water into an elderly individual, even though his kidneys are working well, he may still develop pulmonary edema if you push his fluids too rapidly, even by mouth. This balance is very delicate.

Finally, I got around answering that question about as well as I know how, Dr. Stieglitz.

DR. WARREN: I should like to add, if I may, Dr. Stieglitz . . .

CHAIRMAN STIEGLITZ: Please do.

DR. WARREN: . . . following up what Dr. Pratt just said about the intestinal tract being the best route for giving both fluid and protein, that it is often necessary with an elderly patient (particularly one who may come in a little confused mentally) to really impress your nursing staff, or other persons whom you are employing, that it is *necessary* for them to devote time to seeing that such a patient gets his fluids.

Insuring his oral ingestion may be a very hard thing to do. There is no use in putting a jug of water, or other fluid, beside the patient and telling him that he has to drink so much in such and such a time. For one thing, you do not write such instructions, and I agree with you that lack of clarity of comprehension on the part of the patient is very important. You have to keep giving him, if it is necessary, a little fluid every few minutes. Often the time will come, sometimes in as quickly as four or six hours, when his mental condition is clearer and his habit formation has already developed sufficiently for him to carry on that medication by himself. Quite often I have seen patients put up with an intravenous drip when in my opinion there was no need for it at all, and the veins and the method might more advantageously been reserved until intravenous injection became a real necessity.

CHAIRMAN STIEGLITZ: That applies not only in the acutely ill and hospitalized individual, but, also to the problem of getting fluids, and particularly proteins, into the elderly ambulatory patient at home.

DR. WARREN: Yes.

CHAIRMAN STIEGLITZ: It is often extremely difficult to persuade the aged to eat sufficient protein-containing foods. There seems to be a generic resistance on the part of the elderly to drinking milk. Perhaps they feel that the prescription of milk is an indication that they are back in their babyhood. They usually resent milk. And the problem of camouflaging proteins in small doses to be ingested at frequent intervals (many small feedings) so that there is better utilization and absorption is often a complicated one.

We have been experimenting—Dr. McCay and some others—in trying to develop a high-protein candy with a peanut butter and soy bean flour base. Dr. McCay's pioneering efforts, which I am sure you all know, attacked this problem by increasing the protein content of bread, because bread constitutes a major dietary element with elderly individuals. In New York State mental institutions the *per capita* consumption of bread by the aged exceeds that of the Navy, as McCay has observed and reported.

One is not going to change habits readily. We have come back to this question of habits, haven't we? But if we can improve the quality of what they eat, letting them follow their own habits, we can improve the nutrition of millions of people. We said we should be honest. Is that dishonest? Well, maybe. But if they get the protein in their bread that degree of prevarication does not seem to be immoral to me.

DR. KOUNTZ: I think one word of caution should be put in at this moment especially about protein feeding. Taking an individual who customarily eats little protein and putting him in the hospital, or persuading him to eat

much more protein than he is accustomed to, may be seriously upsetting. This brings up the question of the value of hydrolyzed food substances, particularly hydrolyzed protein. It has been our experience that the use of hydrolyzed protein fits very nicely into early preparation for the better utilization of food or the more liberal administration of proteins. In individuals who are customarily not used to protein, or whose protein intake has long been limited, it is frequently wise to first give them a certain proportion of hydrolyzed protein with a gradually increasing amount of undigested protein substance.

So it seems to me that one must also look at the fact that the gastro-intestinal tract of the elderly individual who has not been on a diet adequate in protein is probably incapable of properly digesting large quantities of protein because the enzymes are reduced. Consequently you have to give him time to develop more vigorous enzyme secretion. If you have to feed him fast, you should use substances that will not require much digestion by his gastro-intestinal tract.

CHAIRMAN STIEGLITZ: Doesn't that suggestion tie in perfectly with the previous comment on the hazards of abruptly changing any or all habits? A dietary habit develops several collateral consequences?

DR. KOUNTZ: Yes.

CHAIRMAN STIEGLITZ: Here is a question from the floor: "Will Dr. Kountz comment on the preferred methods of measuring thyroid function?"

DR. KOUNTZ: I believe that the preferred method is determination of the basal metabolic rate, despite all its drawbacks. It must be realized that you should not depend on one metabolic determination, and give consideration of the state of health of the individual. If he is acutely ill, the chances are his metabolism will be high, whether his illness is associated with fever or whether it is due to heart failure; in fact, no matter what the illness is due to. Even in hypothyroid heart disease with cardiac failure, the metabolism will rise. It may be on the positive side. Therefore, one has to use considerable judgment when he does apply basal metabolism determination as his index of thyroid function.

Of course, there are two other ways. One is the pickup by the thyroid of radioactive iodine. This gives a fairly accurate estimate of the relative activity of the thyroid, but is not too satisfactory. The technique is beset with certain difficulties; interpretation of findings might be very tricky with old people. There also is the method of blood iodine levels. This involves very complicated techniques. Oftentimes just the fumes of iodine in the laboratory may give you a value that is not correct.

Therefore I think that we ought to stick to the basal metabolic rate, plus our clinical judgment, because these other more complicated methods are even less consistent with clinical results. These other two can well supplement and increase our knowledge. Of the two, I think the use of radioactive iodine, measuring its pickup by the thyroid gland, is probably the more reliable and more easily done of the two.

QUESTION: How about blood cholesterol content?

DR. KOUNTZ: That gives you some slight index, but it is a very poor index. I have seen hypothyroidism with a basal rate of minus 30 and a cholesterol of 140, and I also have seen a cholesterol of 500 in individuals without signs of hypothyroidism.

I would like to say this about the cholesterol: our experience is that as people age, the cholesterol level drops. This is in spite of the fact that there has been so much said about high cholesterol levels producing arteriosclerosis. It is my idea that emphasis of the relation of hypercholesterolemia to the genesis of arteriosclerosis will gradually disappear from medical literature. (Applause)

CHAIRMAN STIEGLITZ: We have only two or three minutes left. Dr. Pratt, I wonder whether you would like to comment on whether age *per se* alters the clinical picture of surgical conditions.

DR. PRATT: Well, the time is pretty short, but I think the answer is both "yes"

and "no." For instance, the elderly individual is going to show a different clinical response to inflammation than the younger person will. Dr. Dewey Bisgard has pointed out that in the younger individual an acute gallbladder will often subside and that thus you can do elective surgery on it later. In the older individual the impression is that an acute gallbladder infection is probably going on to gangrene and you had better get it out or drained promptly.

We also know that age in itself does not necessarily influence wound healing. If the nutritional state and vitamin C are up, the wound in an older individual will heal just as well as it does in a younger individual. There is no direct evidence to indicate that just because of age tissues are not going to heal well.

Incidentally, we prefer a long incision, because we have found out that an incision does not heal from the ends but rather from the sides.

If we remember that the individual at any age can tolerate surgery well done, if he is in condition for it, and also remember, secondly, that the response to disease is going to vary with age, then I think we will recall the two most important principles pertaining to surgery upon the aged.

CHAIRMAN STIEGLITZ: Thank you.

Dr. Warren, I wonder whether you would be kind enough to close the discussion by commenting on the hazard of evading diagnostic responsibility by assuming that symptoms and complaints are attributable to age *per se*?

DR. WARREN: I can only answer this, of course, for my own country. There is a distinct lack of responsibility often exhibited by a physician to whom a patient goes, making certain complaints, by referring the patient back to himself with no advice and making such remarks as, "What can you expect at your age?"

I think one of the things that it is important for all of us to remember is that senescence, or aging, or any other term that you would like to apply to a person who is getting old, is a slow, almost physiologic process. Anyway it is a slow process. And if an elderly person suddenly starts to fall down frequently, or gets what he describes as blackouts, or becomes very weak rather quickly so that he cannot do many of the things that he had hitherto done, it behooves one to try to find some medical explanation for these symptoms and not attribute these recent complaints to his advanced years. I have had instances of all these complaints sent to me, labeled as senility. But in every one there was a definite pathologic basis for the recent symptoms. On one or two occasions the reason has been an extremely low hemoglobin, due to an almost terminal stage of pernicious anemia. The patient had said, "I go out and I fall down, and I am too weak to get up," but she has been told by her doctor: "Well, you are 78. What can you expect?"

I think it is up to us in the profession to bear this in mind and really try to educate ourselves and those working with us, as well as the community as a whole, that old age comes on slowly and not abruptly with such dramatic episodes as falling down and having blackouts and being profoundly weak.

CHAIRMAN STIEGLITZ: Thank you.

We want to apologize that not all the questions which were submitted could be presented to the panel. This discussion could continued nearly *ad infinitum* or at least until we all aged to the point where we would be unable to perceive the answers.

I want to thank you, and the participants of the panel.

(The meeting adjourned at twelve-fifteen o'clock.)

CURRENT COMMENT

Grant from the Forest Park Foundation to the Journal of Gerontology

Additional pages in the January and April, 1952, numbers of the Journal of Gerontology have been made possible by a grant from the Forest Park Foundation of Peoria, Illinois. The Journal is most grateful inasmuch as this grant has enabled us to publish many papers presented at the Second International Gerontological Congress which otherwise could not have been included.

Conference on Problems Related to Retirement

The National Committee on the Aging of the National Social Welfare Assembly and the MacGregor Fund of Detroit announce a national conference to be held January 24-26, 1952, at Arden House, Harriman, New York, on the subject of issues related to the retirement of older workers.

The purpose of the conference is stated as follows: "Since chronological age has not proved acceptable as the sole basis for retirement policy, the purpose of the Conference will be to explore what other and additional yardsticks there are, or need to be developed, for determining how long and under what conditions, older workers should continued in employment or be retired."

The conference will be devoted to discussion of such questions as 1) Are there practical ways of making the continued employment of older workers more satisfactory to both the worker and the employer? Under what circumstances is it more feasible to try to adapt the worker to the job or the job to the worker? 2) Under what circumstances is the older worker in general an asset or a liability to industry? Is the employment of older workers consistent with American emphasis on mass low unit cost production? 3) Under what circumstances is the state of health and competence more important than age as a retirement factor? 4) Is there or can there be worked out a substitute for retirement policy based on age acceptable to both management and labor which can be effectively and fairly administered?

As part of the preparation for the conference, a series of monographs are being prepared and will be distributed to conferees the first part of January. These monographs will cover subjects which were considered by the planning committees either too controversial or about which there is too little general information to lend themselves to discussion during the limited time of the conference proper. The subjects for the monographs are 1) Can the economy afford the loss of production of its older workers or the additional burden of maintaining them? What is the effect of changes of the business cycle on employment and retirement practices? 2) What are the respective responsibilities and potential contributions of employers, individual workers, labor unions, and the government and how can most effective use be made of their resources? 3) From the point of view of the worker, is it likely to be better for him to continue in employment as long as he is able to work or to retire at a given age?

The membership of the conference will be approximately 75 persons, including representatives from the fields of industry and business, labor, government (including the legislative branch), economics, medicine, psychiatry, psychology, rehabilitation, social work, and bio-mechanics.

Chautauqua Workshop

The first adult education workshop on gerontology was held July 16-27, 1951, at Chautauqua, New York. The workshop was sponsored by the Department of Adult Education, School of Education, New York University, and the university certified graduate credits for participation.

The staff of the workshop included John Carr Duff, Wilma Donahue, and Clark Tibbitts. Dr. Lionel Z. Cosin of Oxford, England, gave two lectures. Dr.

The establishment of the JOURNAL OF GERONTOLOGY was made possible by a grant from the Josiah Macy, Jr. Foundation.

The hieroglyphics, "The Beginning of the Book for Transforming an Old Man into a Youth," at the top of this editorial page, are from the Edwin Smith Surgical Papyrus, translated by Professor John Breasted, University of Chicago Press.

Clara S. Webster of Tucson, Arizona, and Dr. Anna E. Roy Robinson of Baldwin, Long Island, New York were consultants.

Mrs. Henrietta Rabe, specialist in gerontology for the Bureau of Adult Education, New York State Education Department, lectured to the workshop group. Mrs. Rabe also addressed an audience of 300 Chautauquans at the Hall of Philosophy outlining the State Department's program of education for aging.

The gerontology workshop at Chautauqua enrolled 41 persons from 13 states and one from the District of Columbia. Eighteen different fields of professional effort were represented. Two insurance companies were represented by executive personnel, and three members of the workshop were proprietors of institutions for the aged. The largest interest area was that represented by adult education.

Detailed plans have not yet been completed, but it now seems assured that the New York University Summer School at Chautauqua will offer during 1952 another gerontology workshop.

United Kingdom Exhibit of Facilities Available for Older People

Visitors to the International Gerontological Congress in St. Louis were conscious of an empty booth which was marked as reserved for the exhibit of the United Kingdom. This exhibit was delayed in transit and did not reach St. Louis before the end of the Congress. It was shown on September 26, 1951, to about 400 persons at a reception given in New York honoring foreign delegates to the International Gerontological Congress, and many persons expressed the desire to examine its contents at greater length.

Dr. R. E. Tunbridge has left this exhibit with the National Committee on the Aging of the National Social Welfare Assembly. It is available in whole or in part to any interested groups throughout the country. The exhibit consists of several panels of mounted photographs; a series of scrap books, illustrated with photographs on the subjects of health, housing, old age homes, hospitals; and a representative collection of books and pamphlets published in Great Britain on gerontology in the last few years. For further details write to Geneva Mathiasen, Secretary, National Committee on the Aging, National Social Welfare Assembly, 1790 Broadway, New York 19, New York.

Committee on Geriatrics

The Philadelphia County Medical Society has recently organized a Committee on Geriatrics. The purpose of the Committee is to stress the significance of gerontologic problems to the medical and allied professions. Dr. Joseph T. Freeman is Chairman. Other members of the Committee include:

Dr. E. L. Bortz	Dr. R. A. Kern
Dr. C. L. Brown	Dr. P. F. Lucchesi
Dr. W. Dunbar	Dr. H. F. Page, Jr.
Dr. T. M. Durant	Dr. S. O. Waife
Dr. E. L. Housel	Dr. L. S. Ylvisaker

Old Peoples Day in Japan

On September 15, 1951, Japan honored its aged in a novel celebration, "Old Peoples Day." The day was originated by the General Council of Social Welfare to impress upon Japan's postwar generation a respect for the aged. In Tokyo, 800 old people were invited to a special program in the Hibiya Public Hall. Each of the guests, all over the age of 70, was given a package of gifts and a place of honor in the celebration.

The keynote of the celebration was service to the state through longevity. The oldest member attending the meeting was 95 year old Jitsuo Saito. The Japanese Welfare Ministry announced that additional homes for the aged would be built in Japan during the current fiscal year. At the present time there are approximately 217 charity homes for the aged operated by Governmental agencies in Japan. These homes care for approximately 15,000 aged, but have a waiting list of more than 100,000.

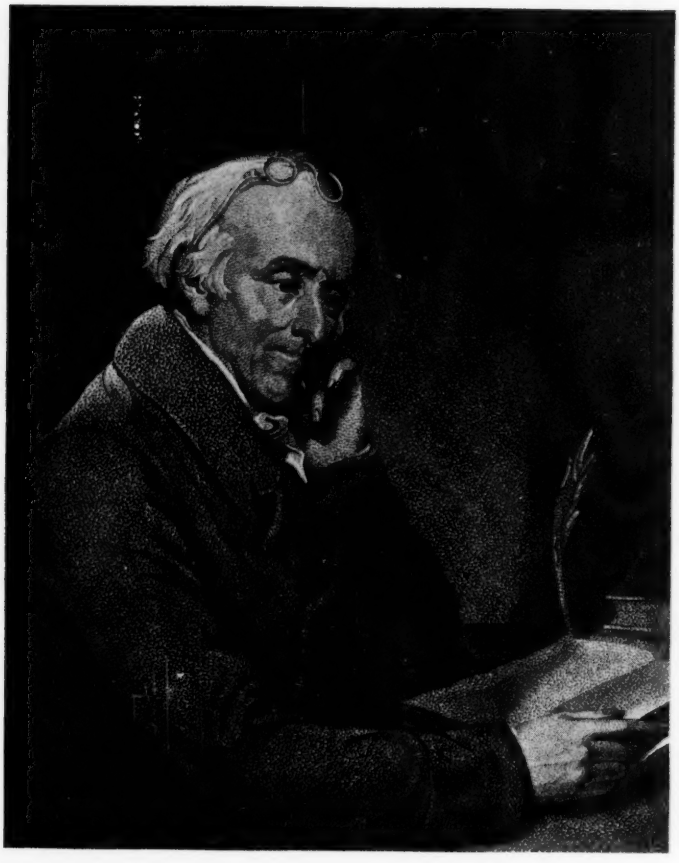
Conference on Medical and Social Problems of the Aging

A Conference on the Medical and Social Problems of the Aging Population was held in Baltimore, September 20-21, 1951, under the auspices of the Committee on Geriatrics of the Baltimore City Medical Society under the chairmanship of Dr. Herman Seidel. Guest speakers at the Conference included Dr. Ronald E. Tunbridge, Professor of Medicine from Leeds University, England, and Dr. Marjory Warren, Head of the Geriatrics Department of Middlesex Hospital, England. Those attending the Conference included representatives from the various state, city, and volunteer agencies concerned with the social and medical care of older people. Discussions were held on the practical problems involved in the organization and operation of various types of programs. The final meeting of the Conference, called as a special meeting of the Baltimore City Medical Society, was concerned primarily with the clinical problems encountered in the care of elderly people.

Discussion of Problems of the Aging

The Institute of Social Order at Rockhurst College began its thirteenth year of service to Greater Kansas City on Wednesday, October 10, 1951, with the opening of the Professional Division. "Problems of the Aging," including medical, social, economic, and moral aspects, was the topic for thirteen discussion hours held every second and fourth Wednesday from 7 to 8 o'clock in Janssens Hall on the Rockhurst campus.

HISTORICAL SECTION



BENJAMIN RUSH (1745-1813), famous American physician, signer of the Declaration of Independence, wrote extensively and lucidly on a variety of subjects. In "An Account of the State of the Body and Mind in Old Age; with observations on its diseases and remedies," published in Philadelphia in 1805, are to be found many worthwhile commentaries. "I have not found that acute, nor that all chronic diseases shorten human life. Dr. Franklin had two successive vomicas in his lungs before he was 40 years old. I met with one man beyond 80, who had survived a most violent attack of the yellow fever; a second, who had had several of his bones fractured in falls, and in frays; and many who had been frequently affected by the intermittants. I met with one man of 86, who had all his life been subject to syncope; another, who had for 50 years been occasionally affected by a cough; and two instances of men, who had been afflicted for forty years with obstinate headaches."

F. D. Z.

ORGANIZATION SECTION

ERNEST W. BURGESS, *President*
University of Chicago
Chicago 37, Illinois

NATHAN W. SHOCK, *Secretary*
Baltimore City Hospitals
Baltimore 24, Maryland

JOHN ESBEN KIRK, *Treasurer*
5600 Arsenal Street
St. Louis 9, Missouri

EDMUND V. COWDRY, *President-Elect*
660 Kingshighway Blvd.
St. Louis 10, Missouri

Minutes of the Sixth Annual Meeting of the Council of the Gerontological Society, Inc.

Held on September 10, 1951

At the suggestion of the President of the Society, the Council meeting was held immediately before the meeting of the Corporation.

The meeting was called to order at 4:00 p.m. on September 10, 1951, in Room 7 of the Jefferson Hotel, St. Louis, Missouri.

Members of the Council present were: W. Andrew, J. C. Aub, E. J. Bortz, E. W. Burgess, G. E. Johnson, O. J. Kaplan, J. E. Kirk, O. H. Lowry, R. A. Moore, Ollie A. Randall, N. W. Shock, and E. Shorr. G. E. Wakerlin was represented by proxy. Also present were: H. A. Schroeder, C. J. Van Slyke, and Marjorie Lawson.

A copy of the Notice of the Meeting mailed to all members of the Council was filed with the minutes.

The minutes of the Fifth Annual Meeting of the Council held November 12, 1950, were approved as published in the Journal of Gerontology, *6:* 48-51, January, 1951.

The reports of the President, Editor-in-Chief of the Journal, and Secretary were received and approved.

President's Report for 1951

As so frequently happens to many of us, especially so it seems when I undertake some task, many things are only partially done or not done at all. This has certainly been the situation in my tenure as your President.

The Gerontological Society, although some six years old, is still in the evolutionary or growing stage. Our place in modern society has not yet been completely established. We ourselves do not know exactly how we should operate, what we should do, and where we should lead.

The most important problem of the year has, of course, been the sponsorship of the Second International Gerontological Congress which we are now attending. The major participation by our Society has been to undertake the publication of the program as a supplement to the Journal of Gerontology. Although this seemed expensive and proved to be even more so, it was my judgment that the prestige which would come to the Journal and the Society far outweighed the expense involved.

A second problem of concern to many people is that of the establishment of a foundation to raise money. At the meeting of the Council last year the proposal to join with the American Geriatrics Society in sponsoring a division in the Medical Memorial Fund was not looked upon with favor. The President was directed to appoint a committee to investigate the entire problem. The Chairman of this Committee is Dr. Chauncey Leake of Texas. Dr. Leake and I have talked about the problem on two occasions and he has corresponded with others. The general conclusion is that the present time is not an opportune one to initiate a public foundation on a national scale.

However, many persons, and I am one of them, believe the Gerontological Society should seize the leadership in this matter by some move which will not prejudice the future. One suggestion is that the Society establish an affiliate type of membership for the laity and start a modest program to interest the public in our problem. I commend this to you for consideration.

Growth in membership brings with it certain problems. Our original sections were Biological Research, Medical Research, and General. Many in fields other than biology and medicine have joined the Society in the General Section. It is my opinion that the time has come to reorganize the sections. How is another question. Perhaps the four sections of the Congress are as satisfactory as can be at the present. Again I recommend some action on this point, primarily to retain the essential multidisciplinary approach of gerontology.

Another problem which must be solved in the next

year is that of our relations to the American Geriatrics Society. I was directed to appoint a special committee for this purpose. This committee in part met with a similar committee of the American Geriatrics Society at Atlantic City in June. Unfortunately I could not attend but have talked with several on both committees. It is clear that an amalgamation is not possible or even feasible or desirable, but that federation may be.

No further progress has been made on the Registry despite efforts by the Chairman of the Committee, Dr. Hueper. I recommend that the Committee be continued because of my conviction that this idea will some day catch on.

Finally, you instructed me last year to appoint a committee to revise the By-laws with a view to allowing more active participation by the Society as a whole in determining policies and electing the Council and officers. Dr. Warren Andrew is Chairman and will present the report himself as he is a member of the Council.

ROBERT A. MOORE
President

Editor's Report for 1951

Since the October issue has not as yet been published, this report is incomplete. There were 326 pages in the first three issues and it is estimated that the four issues of volume 6 will contain a total of 444 pages, which with the 201 page supplement to the July issue will make a total of 645 pages. In addition to the 29 original papers published in volume 6, the April issue contained the Proceedings of the Symposium: Studies on Arteriosclerosis, comprising 7 papers presented at the Third Annual Scientific Meeting of the Gerontological Society, Inc. These 36 papers cover the following fields:

Biologic and Medical Sciences	27
Social Sciences	7
Humanities	0
General	2

The volume also contains 1 review paper, 5 gerontologic reviews, 1 paper in the contemporary opinion section, 3 reports from foreign correspondents (Great Britain, France, and Finland), and 2 reports on international gerontologic conferences.

The program of the Second International Gerontological Congress was published as a supplement to the July issue and was sent to all subscribers to the Journal of Gerontology. In addition to the 201 pages previously mentioned, 8 more pages containing additions to the program were printed for distribution at the Congress.

In the 10 months from November 1, 1950, until September 1, 1951, 52 papers were submitted for publication; of these 15 have been published, 16 were rejected, and of the 21 as yet unpublished, 11 have been accepted for publication and action on 10 has not yet been completed. In addition, during this period, 1 review, 1 contemporary opinion, 5 gerontologic reviews, 3 reports from foreign correspondents, and 2 reports on gerontologic conferences were also submitted, all of which have been published with the exception of one gerontologic review. The 18 unpublished papers cover the following fields:

Biologic and Medical Sciences	16
Social Sciences	1
Humanities	0
General	1

Other statistics on the editorial make-up of volume 6 according to sections are:

Contemporary Opinion	1 Topic
Current Comment	16 Items
Organization Section	44 Pages
Gerontologic Reviews	5 Topics
Book Reviews	23 Books
Index of Current Periodical Literature	106 Pages
Author Index to Literature	15 Pages
Index to Volume 6	4 Pages

Several direct mail campaigns were conducted, copies of the Journal were sent to various meetings, and the Journal has an exhibit at the Second International Gerontological Congress.

There has been an increase both in members of the Gerontological Society and in subscribers to the Journal this year. As of September 5, there are 1247 names on the combined membership and subscription list.

JOHN ESBEN KIRK
Editor-in-Chief

The Treasurer presented a report for the first eight months of 1951 and stated that a complete financial report would be available after the annual audit at the end of the calendar year. The report was approved and ordered filed with the minutes.

A contribution of $100 from the Gerontological Society, Inc. to the National Society for Medical Research was authorized.

The Nominating Committee submitted the following slate of officers of the Council for 1952:

President	E. W. Burgess
President-elect	E. V. Cowdry
Treasurer	J. E. Kirk
Secretary	N. W. Shock

The following individuals were nominated to serve on the Council for three years as representative of their respective sections:

Medical Research	R. A. Moore
Biological Research	A. I. Lansing
General	C. Tibbitts

Reports by the Chairman of the Committees on Membership, Program, and Constitution and By-Laws were received and approved. The current status of the membership of the Society is shown in Tables I and II.

The report of the Registry Committee was received and approved. Although progress seems slow, the

TABLE I. MEMBERS

Total full membership, November 1, 1950		378
New members (to September 1, 1951)		260
		638
Resignations	18	
Members in arrears for 2 years (dues not paid 1950–1951)	14	
	—	32
Active members in good standing September 1, 1951		606

TABLE II. MEMBERSHIP OF GERONTOLOGICAL SOCIETY BY FIELDS OF INTEREST

Fields of Interest	Year					
	1946	1947	1948	1949	1950	1951
Clinical Medicine and Medical Research	43	73	101	164	190	324
Botany	1	1	1	1	0	0
Anatomy and Pathology	9	15	16	19	37	49
Biochemistry	4	4	5	6	15	21
Physiology	7	9	16	22	27	47
Psychology	6	9	14	22	39	46
Sociology	5	5	6	12	17	19
Social Work and Institutional Administration	2	6	11	18	31	59
Nursing	0	0	1	2	5	7
General	3	5	8	19	17	34
Total Members	80	127	179	285	378	606

hope was expressed that ultimately a significant registry of gerontologic material would be developed.

The report of the Affiliation Committee was received. The Council decided that any close affiliation or federation with one specific society is inadvisable at this time. Consequently, the Affiliation Committee was discharged with thanks and the officers of the Society were instructed to work in cooperation with the American Geriatrics Society.

The Committee on Public Foundation reported that although the formation of a public foundation to solicit funds for the support of gerontologic research was most desirable for the future, the present time did not seem appropriate.

The general policy of holding meetings of the Gerontological Society in association with the annual meetings of different professional societies was reaffirmed. In accordance with the policy, the 1952 annual meeting of the Society will be held in Washington, D. C., during the first week of September. This meeting will be held at the same time as the annual meeting of the American Psychological Association.

In accordance with the proposal submitted in the President's report, the Committee on Constitution and By-Laws was instructed to prepare definite proposals to; 1) increase the number of sections of the Society to give appropriate recognition to all professional groups and scientific disciplines concerned with the problems of aging and 2) to set up a new category of membership to include lay people interested in aging from either a personal or service standpoint at a lower membership fee without a subscription to the Journal. It was regarded as essential that the Society prepare material of interest to lay people to be distributed in lieu of the Journal of Gerontology.

There being no other business, upon motion duly made, seconded, and carried, the meeting was adjourned.

N. W. SHOCK
Secretary

Minutes of the Sixth Annual Meeting of the Members of the Corporation of the Gerontological Society, Inc.

The meeting was called to order at 6:00 p.m. on September 10, 1951, in Room 7 of the Jefferson Hotel, St. Louis, Missouri.

Members of the Corporation present were: W. Andrew, J. C. Aub, E. J. Bortz, E. W. Burgess, G. E. Johnson, O. J. Kaplan, J. E. Kirk, O. H. Lowry, R. A. Moore, Ollie A. Randall, N. W. Shock, and E. Shorr. G. E. Wakerlin was represented by proxy. Marjorie Lawson was also present.

A certified copy of the Notice of the Meeting was filed with the minutes.

The minutes of the Fifth Annual Meeting of the Members of the Corporation of the Gerontological Society, Inc. were approved as published in the Journal of Gerontology, *6:* 47-48, 1951.

The reports of the Nominating Committee and the Treasurer were accepted as given in the meeting of the Council.

There being no other business, upon motion duly made, seconded, and carried the meeting was adjourned.

N. W. SHOCK
Secretary

Minutes of the Fourth Business Meeting of the Gerontological Society, Inc.

Held on September 12, 1951

The meeting was called to order at 4:15 p.m. in the Crystal Room of the Jefferson Hotel, St. Louis, Missouri.

Dr. R. A. Moore, President of the Society, acted as Chairman of the meeting. Dr. N. W. Shock acted as Secretary.

Dr. Moore presented a report of the Council Meeting.

Council Report

Your Council has held one formal meeting during the year on last Monday, September 10, here in St. Louis. However, during the year there was considerable correspondence among members and with the chairmen of committees.

The business of the Council for the past year may be arranged in six categories:

1. Sponsorship of the Second International Gerontological Congress.
2. Establishment of a Public Foundation.
3. Rearrangement of the Sections of the Society.
4. Creation of a Special Membership for Interested Lay Persons.
5. Time and Place of Meetings.
6. Revision of the By-Laws.

At the last annual meeting, that is, in November, 1950, the Council accepted the sponsorship of the Second International Gerontological Congress. Our part specifically has been to publish the program as a supplement to the Journal of Gerontology. Although this has been expensive, it seems to us that the prestige which has come and will come to us because of this is adequate compensation.

Several people in and out of the Society have suggested that the Gerontological Society should itself undertake to carry on a public campaign for funds or should assist in the establishment of another organization. One proposal was to join with other interested societies in sponsorship of a division on gerontology of the Medical Memorial Fund. The Council last year came to the conclusion that a move of this type required extensive study and requested the president to appoint a special committee. I did so and designated Dr. Chauncey Leake, Vice-President of the University of Texas, as Chairman.

This Committee has come to the conclusion and the Council concurs that the present time is not an opportune one to engage singly or jointly in a public campaign in this field. However, we do believe that the Society should continue to study this problem and should take steps to hold the interest of the laity. I shall speak in a moment about this.

The membership of the Society continues to grow; we now have 606 members. When the Society was established the membership was made up largely of biologists and physicians. Hence three sections were established: Biological Research, Medical Research, and General. It was the hope of the founders that the Society would be multidisciplinary and that sociologists, economists, psychologists, social workers, and others would join and take an active part. Although one half of the present membership is still composed of physicians, we have made more than a beginning in realizing this hope.

It is the belief of your Council that the time has come to give groups other than biology and medicine proper recognition and the By-Laws Committee has been instructed to work over this problem and bring in specific recommendations next year. I am sure that the Chairman of this Committee will be glad to receive your suggestions. The Council has suggested that the discussion be initiated on the basis of the four sections of the Congress, that is; 1) Biology and Medicine, 2) Sociology, Psychology, Education, and Religion, 3) Economics, Employment, and Welfare, and 4) Medical Services, Hygiene, and Housing.

Now, to return to the problem of the laity. Your Council has recommended that the By-Laws Committee give consideration to the creation of some type of membership for the laity at reasonable dues. No decision has been reached, but at the moment we are attracted by the following ideas: 1) to have all scientific members be called fellows and the lay members designated as members, 2) to limit power to vote to fellows, 3) to charge dues of $3.00 to $5.00 for membership, and 4) to supply members with some type of bulletin which will keep them informed on ideas and advances in the field. Again, I am sure the Chairman of the By-Laws Committee would be grateful for your comments on this plan.

For several years your Council has given serious consideration to the time and place of the annual scientific meeting, especially in relation to other societies. The founders believe that, at least during the formative years, it would be most productive in terms of the idea of a multidisciplinary society if we met with different groups. The converse of this is that we would tie ourselves to any one time, city, or other group.

During the year a special committee has met on one occasion formally and on several occasions informally with a similar group from the American Geriatrics Society to determine whether or not a joint meeting with these two societies in the form of a federation of societies for the study of aging would be feasible or desirable. Although there are

some advantages to such a meeting, there are also disadvantages. The principal disadvantage is that the American Geriatrics Society by its constitution must meet with the American Medical Association. The opinion was expressed by the Council members that a meeting in June in Chicago would not be desirable for most of the nonmedical members. Your present Council, therefore, reiterates its belief in the original policy and has selected Washington, D. C., and the week-end following Labor Day as the place and date of the 1952 meeting. The reason for this decision is that the sociologists and psychologists are meeting in the same part of the country at about the same time. These are two groups with which we have not met. I am certain your new President, Dr. Burgess, would appreciate any comments you wish to send him on this important matter of place and date of meeting.

When the Gerontological Society was organized it seemed desirable to incorporate in order to handle properly the funds of the Society, including a grant from the Josiah Macy, Jr. Foundation. In an incorporated society most business must be transacted by the Council, the members of which are at the same time the directors and members of the Corporation. This, of necessity, deprives the general membership of some voice in the final decisions. Many have been concerned about this, and the Council last year directed the President to appoint a committee to explore the matter. Dr. Warren Andrew is Chairman of this Committee. Because of the need to discuss in the Council ideas on sections and membership before the Committee acted, no report is made this year. However, again I am sure Dr. Andrew or the new Chairman will be glad to have your suggestions for what we might call "liberalization" of the Society.

That covers all business discussed by the Council except the report of the Nominating Committee, and before presenting that I shall ask for comments and discussion of the report.

ROBERT A. MOORE
President

There was discussion with regard to the proposal of the President to alter the sectional structure of the Society and expand the membership to include lay members. The action of the Council was concurred in by the members present.

Nominations of the Council for the following officers to serve during the coming year were presented:

President	E. W. Burgess
President-elect	E. V. Cowdry
Treasurer	J. E. Kirk
Secretary	N. W. Shock

and the following members of the Council, each to serve for three years:

R. A. Moore	Medical Research
A. I. Lansing	Biological Research
C. Tibbitts	General

It was moved, seconded, and carried that the Secretary be instructed to cast a unanimous ballot for the slate as nominated.

The desirability of providing information of practical value to organizers of community projects was brought out in the discussion. It was considered desirable that the Society sponsor the preparation and circulation of such material, preferably as a supplement to the Journal of Gerontology. Although it did not seem feasible to inaugurate a special supplement at the present time, the opinion was expressed that some material of this kind should be included in the Journal during the coming year.

There being no other business, upon motion duly made, seconded, and carried, the meeting was adjourned.

N. W. SHOCK
Secretary

Officers and Council of Gerontological Society, Inc., 1952

President	Ernest W. Burgess
President-elect	Edmund V. Cowdry
Treasurer	John Esben Kirk
Editor-in-Chief	John Esben Kirk
Secretary	Nathan W. Shock

Medical Research:	*To Serve Until:*
Ephraim Shorr	1952
Edward J. Bortz	1953
Robert A. Moore	1954

Biological Research:	*To Serve Until:*
George E. Wakerlin	1952
Warren Andrew	1953
Albert I. Lansing	1954

General:	
Ollie A. Randall	1952
Oscar J. Kaplan	1953
Clark Tibbitts	1954

Fifth Annual Scientific Meeting of the Gerontological Society, Inc.

Notice of Meeting and Call for Papers

The Fifth Annual Scientific Meeting of the Gerontological Society, Inc. will will be held September 6 and 7, 1952, in Washington, D. C., at the Willard Hotel.

Members are invited to submit titles and abstracts (250) words, in duplicate, of communications to be presented at the meeting. Members may introduce non-member author's abstracts. Presentations will be limited to ten minutes.

Titles of papers to be considered for presentation should be sent by March 1 to the Chairman of the Program Committee, Dr. Anton J. Carlson, Department of Physiology, University of Chicago, 951 East 58 Street, Chicago 37, Illinois. If feasible, drafts of papers should be submitted with the title; if the text is not available, a brief description of research methods and findings should be included. Abstracts of papers must be received by the Chairman of the Program Committee by April 10 in order to insure publication in the July issue of the Journal of Gerontology.

CHAIRMEN OF THE COMMITTEES FOR 1952

Nominations Committee: ..... Robert A. Moore

Program Committee: ..... Anton J. Carlson

Registry Committee: ..... Wilhelm C. Hueper

Constitution and By-Laws Committee: ..... Warren Andrew

Membership Committee: ..... Nathan W. Shock

Local Arrangements Committee for Fifth Annual Meeting: ..... Clark Tibbitts

Complete committee membership will be published in a later issue.

International Association of Gerontology
Meeting of the Governing Body, September 14, 1951

MEMBERS PRESENT

Dr. V. Korenchevsky
Head of Gerontological Research Unit
Oxford, England

Dr. T. Geill
De Gamles By, Norre Alle 41
Copenhagen, Denmark

Dr. P. Alessandrini (Acting for Prof. E. Greppi)
University of Rome
Rome, Italy

Dr. F. Henschen
Karolinska Sjukhuset
Stockholm 60, Sweden

Dr. M. W. Warren
Geriatric Unit
West Middlesex Hospital
Isleworth, Middlesex, England

Dr. R. E. Tunbridge
Department of Medicine
Leeds University
Leeds, England

Dr. E. Jalavisto
University of Helsinki
Institute of Physiology
Helsinki, Finland

Dr. A. P. Thomson
Dean of Medical School
Birmingham University
Birmingham, England

Dr. J. Reis, Jr.
Calçada da Ajuda 145
Lisbon, Portugal

Dr. F. Bourlière
Faculté de Médecine
8, Rue Huysmans
Paris, France

Dr. J. Firket (Acting for Dr. L. Brull)
Institut de Pathologie
Hôpital de Bavière
Liège, Belgium

Dr. M. Pañella-Casas
Chef de Service de Geriatría,
Hospital Municipal de Na. Sa. de la Esperanza
Barcelona, Spain

Dr. A. von Albertini (Acting for Dr. A. L. Vischer)
Histopathologisches Institut
10 Schmelzbergstrasse
Zürich, Switzerland

Dr. E. V. Cowdry
Washington University School of Medicine
Department of Cancer Research
660 S. Kingshighway
St. Louis, Mo.

Dr. L. van der Horst (Acting for Dr. J. G. Sleeswijk)
Director, University of Amsterdam
Department of Neurology
Amsterdam, Holland

Dr. J. A. Huet
Chef du Service de Radiologie de la Maison
19 Ave. de la Marne
Asnières, France

Dr. Firket stated that the following Societies were asked to join the International Association of Gerontology:

Patronato Nacional de Ancianos e Invalidos (Venezuela)

Sociedad Mexicana de Geriatría

Dr. Firket presented a letter from Dr. Max Bürger of Germany to Dr. Cowdry requesting that the people listed in the letter be made members of the International Association of Gerontology.

Nominating Committee, Dr. Firket, Chairman: The following nominations for officers of the International Association of Gerontology were proposed by the Nominating Committee:

Dr. L. Brull, President
Dr. T. Geill, Second Vice-President
Dr. M. W. Warren, First Secretary
Dr. F. Bourlière, Second Secretary
Dr. A. von Albertini, Treasurer

It was also proposed that Dr. Cowdry be placed on the Executive Committee, that the First Vice-President be decided upon later, and that a member be elected from Great Britain.

Dr. Tunbridge suggested that the next meeting of the Association be held in July or September of 1954 in Great Britain. The hope was expressed that a large number of social and economic experts would attend. In summarizing it was decided to leave the exact time and the attendance to the decision of the members from Great Britain.

Dr. Cowdry suggested that someone be elected to help the Executive Committee represent the Governing Body and Dr. Tunbridge was so elected.

Finance Committee: Dr. Warren suggested that if Dr. von Albertini could not attend meetings that Dr. von Albertini appoint someone to take his place.

Committee of Service: Dr. Reis, Dr. Bourlière, and Dr. Warren were suggested to contact WHO in Geneva. The question then arose as to whether one person or a group should make the contact with WHO. It was decided to accept Dr. Huet's offer to act in this capacity.

Dr. Jalavisto suggested that a telegram be sent to Dr. Brull expressing regret that he could not attend the meeting and thanking him for all he had done previously to make the meeting a success.

Dr. Korenchevsky suggested that the Research Session on the Endocrinologic Aspects of Ageing be continued in the International Association of Gerontology as long as desirable. The Governing Body approved.

Dr. Tunbridge in behalf of the Governing Body thanked Dr. Cowdry for all his efforts in conducting the Congress and meetings of the Governing Body to a great success.

L. Van Der Horst
Secretary Pro Tem

GERONTOLOGIC REVIEWS

THE GENETICS OF LONGEVITY

The importance of understanding the hereditary basis of the duration of life is directly proportional to progress in the control of the environment. For as an approach is made toward the conquest of accidents, disease, and environment extremes, the innate factors determining longevity are relatively free to pursue an uninterrupted course.

The infinite and indirect ways in which the environment can influence an organism have largely obscured the effects of heredity. This, combined with the vast array of genetic phenomena which are known to be involved, makes it difficult to explain longevity in simple Mendelian terms, and probably led Pearl (Ancestry of the Long-Lived, Johns Hopkins Press, Baltimore, 1934) to the interpretation that there may be other mechanisms involved in the inheritance of life span besides the generally accepted principles.

That the duration of life has a hereditary basis was inferred by Aristotle (Historia Animalium) when he recognized it as a species characteristic. But the biologic importance of life span was not emphasized until Weismann (Essays on Hereditary, Clarendon Press, Oxford, 1891) realized its hereditary dependence and its relationship to the reproductive cycle and other requirements of the whole organism.

Measurements of the intensity of inheritance of longevity were proposed by Galton (Inquiry into Human Faculty, Macmillan, London, 1883) but were not begun until Richardson (Longman's Magazine, *12:* 381-400, 1888) estimated life expectancy (not including accidents) by averaging the ages at death of parents and grandparents. The error introduced by this method is largely due to the improbability of inheritance from all four grandparents being equal. Nevertheless, this type of analysis is valid for a large group providing corrections are applied for the nonhereditary increase in the average age of death that has taken place during the past century.

In the first significant study of the inheritance of longevity Beeton and Pearson (Biometrika, *1:* 50-89, 1901) found coefficient of correlation between the life spans of parents and offspring ranging from 2 to 7 times the probable error. Although positive correlations in familial measurements cannot be interpreted as solely due to heredity, the magnitudes are such as to rule out the exclusive role of the environment. Bell (Duration of Life and Conditions Associated with Longevity, Privately Printed, Washington, D. C., 1918) demonstrated that on the average as the parental life span increases the age at death of the offspring also increases. In a study based on Scandinavian geneologies Jalavisto (Revue Médical de Liège, *5:* 719-722, 1950) has shown that the children of short lived mothers are genetically short lived and that maternal age at birth is an influencing factor in the length of the offspring.

Pearl (Ancestry of the Long-Lived, Johns Hopkins Press, Baltimore, 1934) found that the average sum of the ages of death of the parents and grandparents of 365 nonagenarians and centenarians was 16 per cent greater than the average age of a group of 143 individuals of a group not chosen with respect to longevity. A wide range of variation existed in the sum of ages of the ancestors of the two groups studied. Twin studies (Kallmann and Sander, Journal of Heredity, *39:* 349-357, 1948) revealed that of same sexed twins the average inter-pair difference in age of death of monozygotes is only one-half that found in dizygotic pairs. In Drosophila, Pearl (American Naturalist, *56:* 174-187, 1922) observed that genetic differences in regard to longevity exist in wild populations and that these differences may be isolated by inbreeding, in which case they remain constant for the isolated groups.

The variety of lethal genes identified in Drosophila and other forms indicates that

practically any locus on almost any chromosome may be involved in longevity. Although Gonzales (American Naturalist, *57:* 289-325, 1923) found that while under standardized conditions some mutants do not measurably affect viability, it is impossible to prove that a mutant cannot influence viability under any circumstances. Gonzales also found that various combinations of mutants affecting longevity with + and/or — effects have a total effect which is equivalent to the algebraic sum and that the intrinsic properties of the mutants were more important than the number involved.

The role of heterosis in longevity was revealed by Hyde (Proceedings of the Indiana Academy of Science, *23:* 113-123, 1913) who crossed two short lived strains and found that on the average the F_1 lived longer. The wider range of expression of the character in the F_2 is further evidence of the involvement of many different genes. Karp (Izvestia Akademii Nauk SSSR Otdelemie Matematiky i Estestvennych Nauk. Ser. Biologii, *2:* 219-250, 1940) inbred Drosophila with cross-over suppressors on specific chromosomes and compared them with flies of heterozygous chromosomal constitution. Flies heterozygous for one, two, or three chromosomes show progressively greater viability, fertility, and longevity than the homozygotes.

The effects of polyploidy indicate that in plants longevity can be, in some cases at least, altered by gene dosage. The effects of polyploidy are not entirely predictable and depend greatly on the nature of the original genotype (Stebbins, Variation and Evolution in Plants, Columbia University Press, New York, 1950).

Chromosomal rearrangements as translocations and inversions not involving changes in the number of genes may not have any effect upon longevity. Deficiencies, especially when homozygous, may have a lethal effect. Length of larval life in Drosophila can be changed by minute bristle deficiencies. Duplications and position effects influencing viability have also been discovered.

The influence of sex is demonstrated by lesser viability of the male in at least seventy species besides man of widely separated taxonomic groups, although exceptions to this rule are common. Human data indicate that longevity has a closer correlation between two brothers and two sisters than a brother and a sister, and between a father and a son and a mother and a daughter than between father and daughter and mother and son (Beeton and Pearson, Biometrika, *1:* 50-89, 1901).

Lansing (Journal of Gerontology, *2:* 228-239, 1947) has observed in rotifers an apparent nongenic factor influencing aging which is cumulative, transmissible, and reversible. Less than full grown rotifers do not display this factor as its time of appearance coincides with the time of cessation of growth.

The influence of inheritance on the duration of life is further obscured by the great number of ways in which the genes can interact during development. The results of such action may range from the specificity of affecting the efficiency of a single enzyme system or antibody formation to the more general activity of a tissue, organ, system, entire body, or even certain aspects of behavior.

The evolution of life span is unique in that genes influencing the trait appear after the termination of the reproductive period and thus cannot be directly selected. In addition it is likely that genes providing for the general adaptability of the organism to its situation exist before, or at least concurrently with, genes influencing its physiologic maximum. Nevertheless, longevity is selective to the extent that it is determined by genes having selectable characteristics appearing before the termination of reproduction. Ploetz (Archiv für Rassen und Gesellschafts Biologie, *6:* 33-43 1909) found that the infantile death rate dropped with the increase in longevity of the parents.

Longevity in turn may affect evolution to the extent that population size, competition, and selection are altered. Stebbins (Variation and Evolution in Plants, Columbia University Press, New York, 1950) points out that differ-

ences in longevity between plants and animals are partly responsible for differences in their genetic systems. In many plants where longevity of a particular genotype may prevail asexually for thousands of years, sexual reproduction serves principally to produce genetic variability. Under such conditions the possibility of a variety of viable inter-species hybrids is greatly increased.

The genetic picture of longevity, then, reveals an extremely complex character of fundamental biologic significance exposed to modification by a wide range of phenomena yet subject to experiment, analysis, and understanding. In practice such understanding can be a valuable adjunct to actuary science, to the evaluation of an individual as a physiologic type, and to the breeder and eugenicist interested in selection of factors producing longevous individuals.

PERRY CLOSE

BOOK REVIEWS

DISEASES IN OLD AGE, by Robert T. Monroe, Harvard University Press, Cambridge, 1951, 402 pages, $5.00.

This valuable publication represents an analysis of the case records of 7941 patients over 61 years of age who were admitted to the Peter Bent Brigham Hospital in Boston over the thirty year period from March, 1913, to March, 1943. The investigation possesses the advantage of dealing with patients who at the time of their admission to the medical service were not inmates of institutions. Of the 7941 patients, 1874 died in the hospital. Autopsies were performed on 1177, or in nearly two-thirds of the cases. The treatment of this vast clinical and pathologic material is done in an exemplary way with major chapters dealing with each of the more important organ systems (nervous, cardiovascular, respiratory, etc.).

One of the features which makes this book of very high standard is the common sense and conservatism which characterize the statements and the conclusions of the author. When such qualities and the author's long experience with diseases in the aged are applied to clinical records compiled over a generation with the greatest care by the staff of the Peter Bent Brigham Hospital, it is not surprising that an excellent result is obtained. In addition to the immediate conclusions from the analysis of the data, the monograph contains numerous considerations and deliberations by the author. These considerations are presented in the same natural style as the other sections of the chapters and are so pertinent and logical that although occasionally deviating from the accepted contentions they nearly always succeed immediately in convincing the reader.

The clinical material presented in the book is limited to aspects of disease as pertaining to old individuals. The assumption is made by the author that the reader is familiar with the facts of medicine as available in ordinary textbooks describing the symptoms and prognosis of the diseases in younger and middle-aged adults. This approach in the opinion of the reviewer is greatly to be commended, since it saves the reader the weariness associated with the perusal of elementary material and makes it possible to present a large body of geriatric facts within a relatively small publication. Although it has not been Dr. Monroe's intention to cover all the aspects of internal medicine, all important internal diseases are included in the monograph. Because of the great skill with which essential features of the diseases are discussed and the large number of cases on which the conclusions are based, this book in the reviewer's opinion would seem to have advanced the knowledge of the gerontologic aspects of internal diseases to a greater extent than any previous textbook in this field.

A review of the mental status of the old people revealed the interesting finding that only 41 per cent of the patients were considered by the medical staff as being mentally normal. This high incidence of mental abnormality is not surprising to physicians who daily examine and associate with old patients, and in the reviewer's opinion constitutes one of the main reasons clinical examination of elderly patients is much more time consuming than the examination of younger adults. This fact also make the possession of a rather high frustration tolerance and of sympathy and respect for old patients a necessity for any sincere person dealing with old individuals.

Concerning the observations on the cardiovascular system, not less than 28.5 per cent of the men and 28.3 per cent of the women were found to have a normal heart at autopsy. It is of considerable interest to learn that the careful survey of the histories for these patients failed to reveal any clue in nutrition, heredity, or previous stresses and strains as to how these old individuals succeeded in avoiding cardiac disease.

The valuable section on coronary artery occlusions contains the statement that scars of healed major infarctions were present in one-third of the autopsy material and lesser scars in the majority. The important fact is further brought out in this study that, whereas clinically women are believed to be affected by coronary occlusion less often than men, the autopsy findings showed that the opposite is true, only 25 per cent of the men but 30 per cent of the women over 61 years having the disease.

The review on nontuberculous infections of the upper respiratory tract likewise contributes a large volume of valuable data. As would be expected the decrease in mortality in recent years from lobar pneumonia is brought out clearly from the study. The virus infections of the respiratory tract are given considerable attention and in the reviewer's opinion constitutes one of the most significant and original sections of the book. The demonstration by Monroe that bronchiectasis in old individuals usually occurs as a disease with comparatively mild symptoms and with a relatively good prognosis is an important finding, especially at a period when surgical treatment is applied with increasing frequency to lesions in the aged. With regard to emphysema a practically complete lack of agreement was noted between the clinical and pathologic diagnoses. This surprising absence of correlation, based on a study of 129 autopsies, is remarkable and should be given careful consideration in future studies of this disease in the aged.

On the basis of an excellent survey of the course of gall bladder disease in old individuals, Monroe

makes a strong recommendation for submitting all patients with gall stones to surgical treatment. Thus the medical mortality for patients with gall stones was 17.8 per cent, which exceeded the mortality associated with surgery for the disease, the latter being 1.6 per cent in patients 61 to 65 years old and 12.2 per cent for those over 66 years.

The frequent occurrence of cystitis in the course of acute virus infections (cold, grippe) is emphasized; this observation agrees well with the impression of most geriatricians and receives a valuable confirmation through Monroe's studies.

The chapter dealing with diseases of the bones and joints contains numerous excellent observations and recommendations, but is less complete than the other sections in the book, probably because of a peculiar tendency of interns and residents to pay insufficient attention to lesions of the bones and joints and therefore to make less careful notes in the histories with regard to these diseases.

Only with a single statement in the book is the reviewer in disagreement. Dr. Monroe claims that excessive irritability of the carotid sinus is found in the majority of old individuals. This has not been the reviewer's experience, but the discrepancy may be due to failure by the reviewer to pay sufficient attention to the syndrome in the patients' histories or to a less exact search for this symptom at the physical examination. The statement by Monroe on the high incidence of carotid sinus hyperirritability will undoubtedly induce many physicians to consider this syndrome when dealing with older patients.

It may be regretted that a survey of the electrocardiograms from this large group of old patients is not included in the book. Such an analysis would of course be very time consuming but might uncover findings of value. The reviewer would also have been very interested in an evaluation of the symptomatology of the patients presenting calcification of the mitral and aortic annulus. This condition is one of the few diseases of a predominantly senile character and for this reason might deserve special consideration in clinical geriatrics.

The reviewer does not consider himself competent to evaluate the observations and recommendations by Dr. Monroe in the field of sociology. He is, however, impressed by the soundness and common sense characteristic also of these sections of the book and certain that they will possess a great appeal to many physicians who have been alienated from this field of gerontology because of the unfamiliar style encountered in many sociologic publications.

The present monograph contains no unattainable projects, but all suggestions reveal the life long experience of the author with the aspects of human nature as it is revealed in medical practice and his reasonable and obvious sympathy with and respect for old individuals. In view of the accomplishment which this book represents the suggestion presents itself to recommend that a similar analysis be undertaken of the case histories of old patients admitted to a surgical department and to the services of various specialties. Since careful histories are available in many hospitals from the beginning of this century, the extension of the study to earlier periods would probably be of great value since more information regarding the natural course of the diseases may be obtained by analysis of the histories and autopsy reports from the time when less adequate therapy was available.

It may be expected that European gerontologists likewise will follow Dr. Monroe's example and analyze the case records from major hospitals in their countries. Even though additional clinical information may undoubtedly be acquired through such efforts, it is unlikely that the excellency of the present monograph will be exceeded.

J. E. KIRK

ALTE MENSCHEN IM ALTERSHEIM: Soziologische, psychologische und medizinische Studien im Altersheim der Stadt Basel (Old Folks in the Home for the Aged: Sociologic, Psychologic, and Medical Studies in the Municipal Home for the Aged of Basel), by Gretel Vettiger, Aniela Jaffé, and Alban Vogt, with an introduction by A. I. Vischer, Benno Schwabe and Co., Basel, 1951, 150 pages, 8 Swiss francs, paper bound.

Admirers of Dr. A. L. Vischer's constructive work for the aged of the city of Basel and of his valuable contributions to the literature of gerontology will welcome this volume made up of contributions by three members of his staff, offered in the hope of awakening interest in the problems of old age and of improving the institutional care of the aged. In his introduction Dr. Vischer gives us recent statistics on the age make-up of the Swiss population, emphasizes that the Home for the Aged is an integral part of the Municipal Hospital and that working with old people should be a required part of the training of physicians and nurses. His preoccupation with institutional problems has in no way limited his vision, for he insists that the aged in municipal and private homes represent but a fraction of the total aged population, namely in Basel 4 to 5 per cent of those over 60 years. He urges that studies be undertaken of the old people living in their own homes in order to give a more complete picture.

In Dr. Vettiger's sociologic study of the Home for the Aged we find a careful historical exposition of the development of the care of the aged in Switzerland generally, and in Basel particularly. This reviewer was especially grateful for the etymologic explanation of the German word, *Pfrund*, the exact significance of which has eluded him for many years. It was reassuring to learn that it means a person

who is supported by a charitable foundation, but that "the expression as currently used is not properly translatable as dependent, pensioner, or even by resident of a home for the aged."

Of unusual value are the individual studies of the residents of the Home for Aged, since here we have a remarkable combination of scientific objectivity with warm human understanding made alive by a real literary gift. We learn too that the Home for Aged accepts transfers from the mental hospital and that alcoholism among the male residents is often a real problem. We soon realize that however different the background, old people in institutions are fundamentally the same the world over.

Miss Jaffé's psychologic studies are based on interviews and Rorschach tests of 47 men and 52 women in the Home. The general adaptation of the old people to age and to life in the home is discussed in illuminating fashion. She found the responses to the Rorschach test sparse and monotonous, but wisely questions whether this is to be attributed to old age alone or rather to the cultural background and intellectual development of the residents. Much of this section will be meaningful only to clinical psychologists.

The third portion of this volume is devoted to the results of pathologic anatomic studies of the diseases occurring in old age by Dr. Alban Vogt, and is based on the analysis of 1836 necropsies performed on residents of the Home during the past twenty-five years. Of interest are the figures on the occurrence of arteriosclerosis. As defined by the writer 99 per cent of all cases showed vascular changes. In 34 per cent arteriosclerosis was the basic disease. Luetic vascular disease occurred in 3 per cent of the cases, a high figure for this age group. An interesting parallel is drawn between the vascular changes in the heart and in the brain. The coronary vessels were affected somewhat more often than the basal brain arteries, 86 per cent as against 75 per cent. Sclerosis of the cardiac vessels was more often the direct cause of death, 3.6 per cent as against 1 per cent. Of further interest is the finding that myocardial scarring occurred in 29 per cent and focal areas of cerebral softening in 27 per cent of the cases. This the author believes indicates the similarity of the effects of arteriosclerosis of the medium sized vessels.

That "endocarditis," otherwise unqualified, was found in 25 per cent of the cases and that in 8 per cent it was the cause of death, is hard for an American physician to grasp. The statement can only be interpreted as the result of grouping together conditions to which we customarily give specific designations.

Emphasis is laid on the frequency of the various forms of tuberculosis in the aged. Gastric and duodenal ulcer, cirrhosis of the liver, and pneumonia are all discussed from a statistical point of view. It is unfortunate that many of the residents of the Home with acute diseases die in the Hospital proper and that their records therefore are not included in this series. If autopsy reports on persons over 60 years of age from both Hospital and Home had been combined, a more inclusive and more valuable picture of disease incidence in the aged would have resulted.

This volume has successfully achieved the goal set by its authors and its sponsor. The professional reputation of this outstanding institution is enhanced by these additions to our knowledge of a most difficult and complex field. It is highly recommended to physicians, psychologists, and to social workers, familiar with German, both as a substantial contribution to their special fields and also as a model for further investigative endeavors.

F. D. Zeman

SKILL AND AGE: AN EXPERIMENTAL APPROACH, by A. T. Welford, Oxford University Press, New York, 1951, 161 pages, $1.75.

This book by Welford and his associates consists of a detailed description of nine experiments designed to investigate the relationship between certain skills and the process of aging and to locate changes in patterns of skill with age. It is to be commended on two main points. First, a theoretical framework has been erected around which the experiments were designed, thereby giving integration to the entire project. Second, a variety of experiments was selected which yield answers having industrial implications.

The book yields more information on aging than on age per se, a fact which will be a disappointment to some workers in the field of rehabilitation of the elderly worker. For example, in some learning tasks the groups were dichotomized as being below or above 30, an age which is hardly regarded as critical in industry. Furthermore, in many of the experiments, subjects beyond the age of 50 were not included. More information about the nature of the sample of subjects would have been helpful in evaluating the results of the various studies.

The experimental methodology is sound, with results from each study conscientiously explored as to their theoretical contributions. Statistical checks were employed, but it seems unfortunate that statistical evidence was separated from each experiment and placed in an appendix.

In general all the separate experiments reported in the book tend to support the author's hypothesis that a primary locus of change with age occurs within the central mechanisms of the receptor side. The breakdown which occurs seems to be more in the process of organizing incoming stimuli and relating them to relevant past experience than in retention of the previous experiences. The techniques employed in the study for analyzing a performance into its multiple components and showing how one or more

of these rather than the performance as a whole can fail with age are noteworthy. For further evidence that many of the supposedly pathologic changes noted in elderly workers are also seen in much younger workers, those dealing with problems of employment of the aged will be grateful.

B. McD. CALDWELL

HOPE AND HELP FOR THE ALCOHOLIC, by Harold W. Lovell, Doubleday & Company, Inc., New York, 1951, 215 pages, $2.75.

This small readable book has been written with the intention that it be of educational value and help to the alcoholic and his relatives.

The magnitude of the problem of alcoholism in the United States and the inadequate facilities for dealing with it are clearly portrayed. It is admitted that the causes of alcoholism are not established and it is emphasized that distortions of personality development seem the more important in some instances, while biologic oversensitivity to alcohol (in relation to constitutional or acquired hypoadrenocorticism) appears of more importance in others; the author believes alcoholism occurs only if both sorts of difficulty are present in the same individual.

The chief virtues of the book lie in its successful communication to the lay readers of a) the professional attitude of the physician dealing with alcoholic patients: the uselessness of blame and pity are strikingly pointed out, b) the absence, to date, of any "cure" for alcoholism, c) the admonition not to spoil the lives of non-alcoholic relatives in attempts to help alcoholics, and d) the care which the alcoholic needs to give to planning a non-alcoholic life for himself.

With regard to the last point, the author recommends that the average patient be under observation for at least one year, that he become an active member of Alcoholics Anonymous, that he stay on a diet intended to dampen blood sugar oscillations, and that he be treated with adrenal cortical extract both acutely and (at times) for considerable periods of time. Intensive psychotherapy is recommended where it is indicated, but is not thought necessary in most instances.

The therapeutic validation of procedures so numerous and complex is obviously a most formidable undertaking. This reviewer is unable to find adequate validating evidence (either of the procedures in toto, or of the particular procedure [correction of hypoadrenocorticism] of special interest to the author), in the book, or in the articles published by the author elsewhere (*Geriatrics*, 1949, 1951). Yet the problem of the alcoholic patient is so serious, both at individual and social levels, that satisfactory demonstration of the theraputic worth of any procedure or combination of procedures is of the greatest importance. Pending such demonstration, the author's statement that glandular therapy is "a valuable aid in treatment of the sick addicted personality," expresses his strong convictions from his clinical experience and is highly provocative; while the total treatment program he recommends represents the best professional practice at the present time.

Careful reading of the book by the alcoholic and those close to him will prove challenging and rewarding.

G. SASLOW

PHYSICAL MEDICINE AND REHABILITATION FOR THE CLINICIAN, Edited by Frank H. Krusen, W. B. Saunders Company, Philadelphia, 1951, 371 pages, $6.50, cloth bound.

There are 24 contributors to this volume; ten of the group are physiatrists. The book is in 4 sections subdivided into 39 very brief chapters. The sections are:

I. Therapeutic Applications of Physical Agents and Procedures.
II. Diagnostic Applications of Physical Agents and Procedures.
III. Clinical Aspects of Physical Medicine and Rehabilitation.
IV. Fundamentals of Anatomy, Therapeutic Exercise and Physiology as Related to Physical Medicine and Rehabilitation.

An obvious rearrangement immediately suggests itself.

The clearest and soundest presentations in the book are those by Martin, who was assigned the chapters on prescription writing, heat, ultra-violet, and cerebral palsy. His physiology is sound and he does not make the mistakes of some of the older writers on physical medicine who always claimed too much and displayed so much ignorance of clinical medicine. Krusen's chapter also show his usual lucid style.

Many of the chapters on physical agents and procedures provide little practical therapeutic or diagnostic information. The discussion of electrodiagnosis by Rose points up the unsatisfactory state of this discipline. No known test gives one the vital information of whether to operate on a peripheral nerve at a time when such information is most needed. It is unlikely that the Golseth-Fizzell technique described by Rose will gain general adoption by the clinician for two reasons: it is too time-consuming and too painful. The article by Roth and Sheard on skin temperatures, while interesting, is also of little help to the practitioner. He is unequipped with constant temperature rooms, thermocouples, and time enough to carry out such tests, even if they were the best circulation tests available. Similarly chapters on microwaves and ultrasound are not for the clinician.

Most of the chapters on treatment are woefully inadequate—so brief as merely to outline the topics

needing development. To take a specific example, the practitioner with a hemiplegic patient will read the article by Dinken. He will note the system of muscle and functional grading, then the author's admission that it is too difficult and time-consuming to be practical. Next he turns the page—and finds himself at the end of the article with little usable information. Fewer topics might have been chosen and developed more fully.

The sections on functional anatomy are drawn extensively from Hollinshead's book on the same subject. They are clear and valuable additions. Wakim's section on physiology is well-written and informative. The over-simplification of muscle tonus excepted, it is authoritative.

The illustrations are uneven in quality and emphasis. Far too many are indolently borrowed from older publications.

This book will attract a restricted audience. It is not for physical therapy students and not for clinicians, despite the title. All physiatrists will find it useful. It is fairly well suited to the needs of medical students getting their first introduction to the subject.

S. MEAD

HANDBOOK OF NUTRITION, Prepared under the auspices of the Council on Foods and Nutrition of the American Medical Association, Second Edition, The Blakiston Company, New York, 717 pages, $4.50, cloth bound.

This new edition of a recognized reference by 33 contributors who are leading authorities in the field of nutrition brings up-to-date basic information concerning nutrition which can be used by dietitians, nutritionists, and physicians. The nutritional requirements of the aging population is given consideration in Section II of the handbook. The book is recommended as a reference for more advanced workers in nutrition.

H. BECKER

BOOKS RECEIVED

Books received since August 1, 1951, are acknowledged in the following list. In so far as space and time permit, some will be selected for review in a later issue, but it is unlikely that all will be reveiwed.

Alte Menschen im Altersheim: Soziologische, psychologische und medizinische Studien im Altersheim der Stadt Basel (Old Folks in the Home for the the Aged: Sociologic, Psychologic, and Medical Studies in the Municipal Home for the Aged of Basel), by Gretel Vettiger, Aniela Jaffé, and Alban Vogt, with an introduction by A. L. Vischer, Benno Schwabe and Co., Basel, 1951, 150 pages, 8 Swiss francs, paper bound (Reviewed in this issue, page 130).

Biological Antagonism, by Gustav J. Martin, The Blakiston Company, Philadelphia, 1951, 516 pages, $8.50.

Camping for the Golden Age, Recreation Project for Older People Group Work Council, by the Welfare Federation of Cleveland, 1001 Huron Road, Cleveland 15, Ohio, 1951, 7 pages, mimeographed.

Changing Years—What to Do About the Menopause, by Madeline Gray, Doubleday & Company, Inc., New York, 1951, 225 pages, $2.75.

Group Work with the Golden Age, by the Welfare Federation of Cleveland, 1951, 12 pages, mimeographed.

Growing in the Older Years, edited by Wilma Donahue and Clark Tibbitts, University of Michigan Press, Ann Arbor, 1951, 204 pages, $2.50.

Man and His Years, An Account of the First National Conference on Aging, sponsored by the Federal Security Agency, Health Publications Institute, Inc., Raleigh, North Carolina, 1951, 311 pages, $3.25.

Physical Medicine and Rehabilitation for the Clinician, edited by Frank H. Krusen, W. B. Saunders Company, Philadelphia, 1951, 371 pages, $6.50 (Reviewed in this issue, page 132).

Planning a Party for a Golden Age Club, Welfare Federation of Cleveland, 1951, 9 pages, mimeographed.

Psychological Dynamics of Health Education, Proceedings of the Eastern States Health Education Conference, April 13-14, 1950, Columbia University Press, New York, 1951, 134 pages, $2.50.

The Public Health Nurse and the Patient, revised edition, by Ruth Gilbert, Harvard University Press, Cambridge, 1951, 348 pages, $3.75.

Studies in Later Maturity and the Aged, Illinois Public Aid Commission, Chicago, 1951, 53 pages, mimeographed.

You Will Like Working with the Golden Age, Welfare Federation of Cleveland, 1951, 14 pages, mimeographed.

INDEX TO CURRENT PERIODICAL LITERATURE

NATHAN W. SHOCK
Gerontology Section
National Heart Institute
National Institutes of Health

The subject categories are those in *A Classified Bibliography of Gerontology and Geriatrics* by Nathan W. Shock published by Stanford University Press, Stanford, California (1951). Only major headings are used and the Roman numerals correspond to those given in the bibliography. In so far as possible, references are classified according to organ systems. Thus most of the material on Geriatrics will be found under the organ system involved in the disease. Cross references are indicated by number at the end of each section. When available, abstract references are given (*B.A.—Biological Abstracts; P.A.—Psychological Abstracts;* and *P.I.—Population Index*). Abbreviations for journals are those used in *A World List of Scientific Periodicals Published in the years 1900-1933,* 2nd Edition. For journals not listed, abbreviations were devised according to the general rules used in the above source. It is impossible to cover all journals and list all papers concerned with aging and the aged. Authors and publishers are requested to call attention to publications or to send reprints to the Gerontology Section, Baltimore City Hospitals, Baltimore, Maryland. The assistance of the Forest Park Foundation, Peoria, Illinois, in the preparation of these materials is gratefully acknowledged.

GERONTOLOGY

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4743. Cowdry, E. V.: Work on aging in a national emergency. *In:* Smith, Kline & French Laboratories, *Second Symposium on the Clinical Problems of Advancing Years.* Phil., 1951, pp. 7-9.

4744. Detroit, Michigan. Public Library: *The older person in the world of today.* The Library, Detroit, 1950, 5 pp.

4745. Donahue, W. T., and C. Tibbitts (Editors): *Growing in the older years.* Univ. Mich. Press, Ann Arbor, 1951, 204 pp.

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4747. Korenchevsky, V.: Gerontology in the United Kingdom. *J. Geront., 6:* 275-287, 1951.

4748. Lansing, A. I.: Some physiological aspects of ageing. *Physiol. Rev., 31:* 274-284, 1951.

4749. Münster, L.: Il primo trattato pratico compiuto sui problemi della vecchiaia; la gerontocomia di gabriele zerbi. *Riv. Geront. Geriat., 1:* (1), 38-54, 1951.

4750. National Conference on Aging. Washington, D. C., 1950: *Man and his years; an account of the first national conference on aging. Sponsored by the Federal Security Agency.* Hlth. Publ. Instit., Inc., Raleigh, 1951, 311 pp.

4751. Shock, N. W. (Editor): *Problems of aging; transactions of the thirteenth conference.* Josiah Macy, Jr. Foundation, N. Y., 1951, 194 pp.

4752. Shock, N. W.: Biology of aging. *In:* T. L. Smith (Editor), *Problem of America's Aging Population.* Univ. Florida Press, Gainesville, 1951, pp. 37-46.

4753. Smith, T. L. (Editor): *Problems of America's aging population.* Univ. Florida Press, Gainesville, 1951, xv, 117 pp.

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